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for Manufacturers of Chemicals for Agriculture

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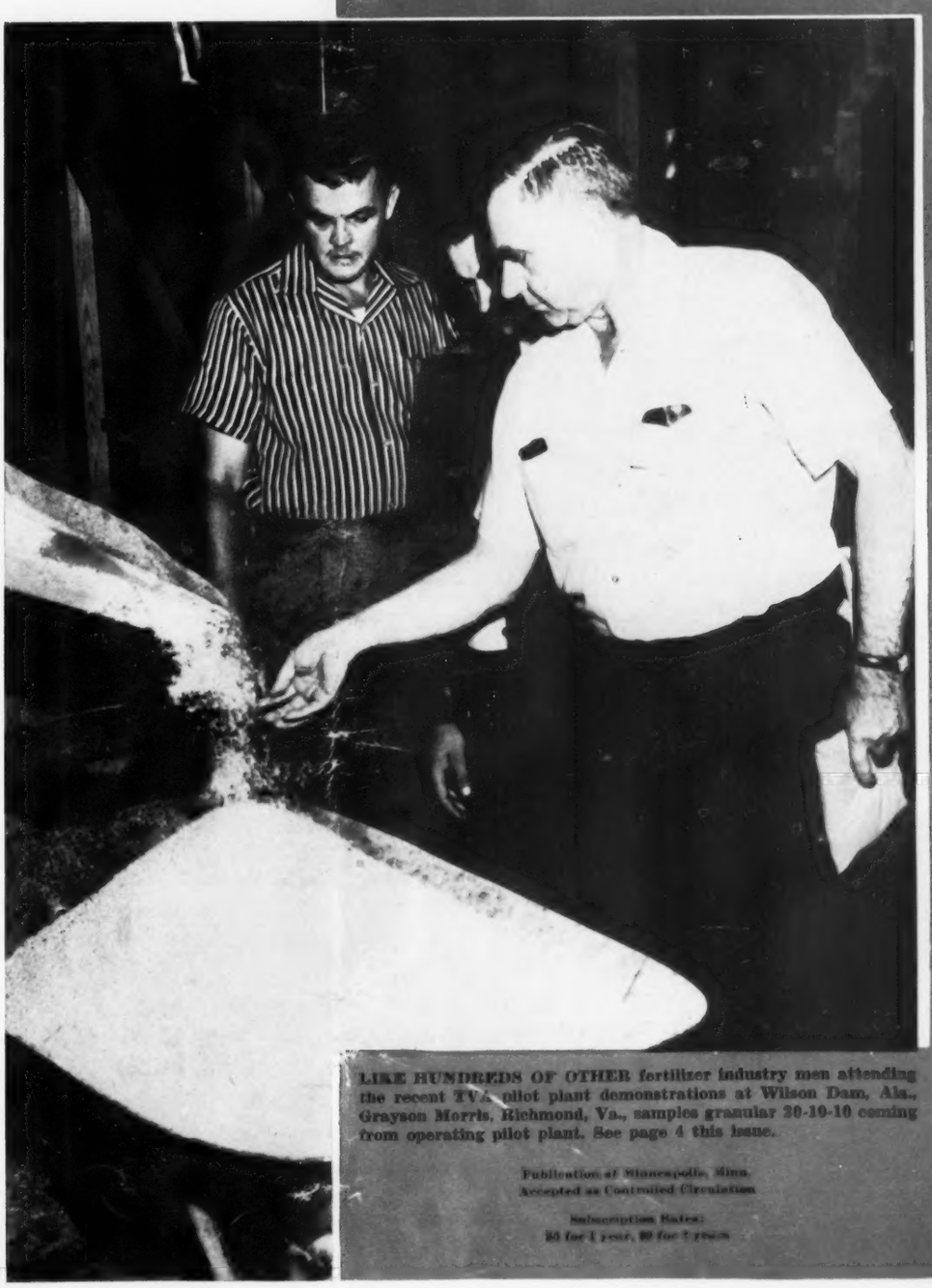

LIKE HUNDREDS OF OTHER fertilizer industry men attending the recent TVA pilot plant demonstrations at Wilson Dam, Ala., Grayson Morris, Richmond, Va., samples granular 30-10-10 coming from operating pilot plant. See page 4 this issue.

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Herbicide Formulations Enhanced Through Use of Wetting Agents

By Virgil H. Freed
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IN ORDER to answer the question of "What do we know about the use of wetting agents with herbicides?" let us find out what this question implies. It seems basically to ask of what value are surfactants in chemical weed control? Although presently not in a position to give a very definite answer, we may be sure that with the vigorous interest in absorption of herbicides by plants, it will not be long until we know a great deal more about the problem.

Obviously our interest in studying absorption and the role of surfactants in this process has a two-fold purpose. First, we are interested in the purely scientific aspects of the problem—wanting to know just how a plant absorbs and translocates chemicals. The second aspect of this problem has a little more practical nature, for it is here that we want to know more about this process in order to turn it to our own advantage.

In other words, we want to know about this process in order to improve formulations of our chemicals to obtain the maximum benefit from their use. This will mean, of course, that we will be looking for the best surfactant to go with any particular herbicide.

One of the basic assumptions we make in believing that surfactants increase the effectiveness of herbicides is that the surfactant increases the amount of chemical absorbed by the plant. We believe that if an increased amount of the chemical gets into the plant, that we will get better results. Let us attempt to answer the question, then, of whether or not this is actually the case if we use a surfactant with an herbicide. Does more of the chemical get into the plant? Let us quickly look at three different tables of data obtained in our studies trying to answer this question.

Table 1 shows the amount of 2,4-D absorbed with and without surfactant:

TABLE 1. Absorption of 2,4-D in Presence of Surfactant

% Surfactant	% 2,4-D Absorbed
0.0	10.1
0.1	36.5
1.0	38.8

Table 2 shows the effect of surfactant upon the absorption of Amitrol or ATA:

TABLE 2. Absorption of ATA in Presence of Surfactant

Solution	Dose/plant	S.T.	pH	% Absorbed in 117 hr.
ATA	250γ	69.6	5.87	55.4
ATA + 0.1% X-77 .	250γ	33.3	5.82	87.3

Table 3 shows the amount of indoleacetic acid taken in over a six-day period with and without surfactant.

TABLE 3. Influence of Surfactant on the Absorption of Indole-3-Acetic (IAA)

	% Absorbed in—			
	1 day	2 days	4 days	6 days
IAA	34	30	42	45
IAA + 0.1% Surfactant A ..	49	60	87	94

On the first day there was an increase of over 15% more absorption of indoleacetic acid in the presence of surfactant and at the end of six days there was a difference of 49%.

Now, the next question is whether or not increased absorption is of any real value in helping to kill plants with chemicals. This question may be answered in the affirmative on the basis of the experience of a number of people who have added surfactants to herbicides.

Another link in the chain of evidence to support the belief that increased absorption also increases the kill is our experience with adding wetting agents to dinitrophenols or to 2,4-D. We know that if we add a wetting agent to dinitros used as selective herbicides we lose the selectivity. In other words, the crop is seriously damaged by this mixture, where it would not be damaged if we used the dinitro salt without the surfactant.

In spraying flax in the midwest, it was found that broad-leafed weeds were controlled with the sodium salt of 2,4-D, but when a wetting agent was added severe damage to the flax resulted. These facts all illustrate that the increased absorption of the herbicide results in more toxicity to the plant.

Now, as sort of a clincher to our argument as to whether the increased absorption results in an increased kill, Table 4 shows the increase in effectiveness of sodium chlorate upon addition of a wetting agent:

TABLE 4. Effectiveness of Sodium Chlorate at 40 Lb./Acre

Solution	S.T.	% Kill
Sodium Chlorate	70.6	10
Sodium Chlorate + 0.1% Multifilm L	33.9	52.5

This would seem to establish quite reasonably that the increased absorption brought about by addition of a surfactant to an herbicide does indeed increase the effectiveness of the treatment.

Now, however, we must face up to the dilemma brought on by the experience of many people who have found no material increase in effectiveness after adding a surfactant. Unless a solution is found to this particular dilemma we will still have skeptics insisting that surfactants are of little value with herbicides.

The cases where surfactants have not given an appreciable increase in kill that have come to my attention usually have been under favorable growing conditions and a heavy application of the chemical. Both of these situations would tend to nullify the effect or gain achieved through the addition of a surfactant.

The addition of a surfactant to increase the effectiveness of an herbicide will show to an advantage

Turn to **SURFACTANTS** page 22

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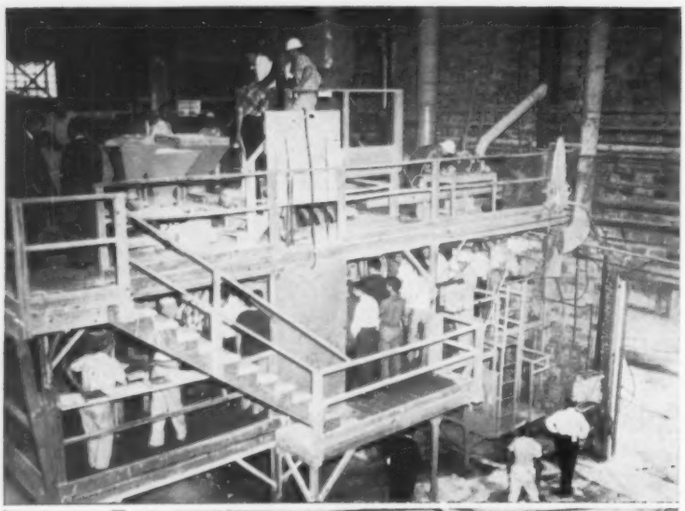
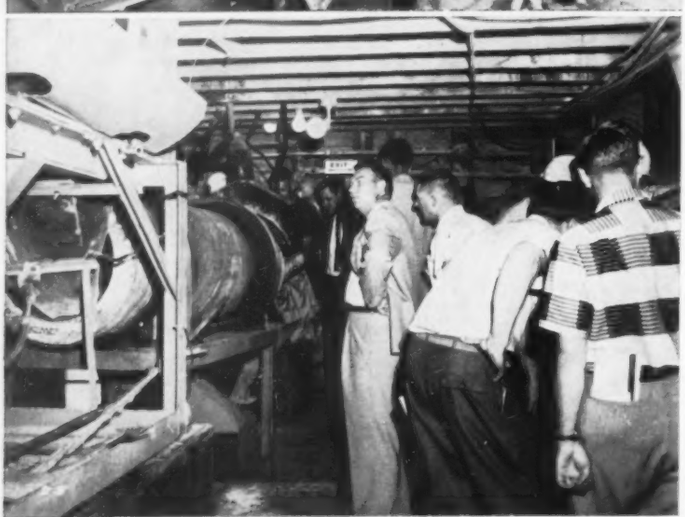




Production Men See Both Liquid and Dry

EDITOR'S NOTE—Subject matter covered at the June 9-11 TVA pilot plant demonstrations was so voluminous and complex that space is not available to cover it in full depth. However, we do present in this issue some of the highlights of the three-day sessions which, along with photos of activities, should give the reader a good idea of the meeting. Additional papers will be presented subsequently.

Below is a paper presented by R. D. Young of the TVA engineering staff at the recent meeting:

FOR SOME TIME there has been considerable interest in the production of granular fertilizers that contain more nitrogen than P_2O_5 or potash. The usual ratio for these "inverse ratio" grades is 2:1:1, the most popular grade being 16-8-8. In recent months the reports of particularly good agronomic results in the use of 16-8-8 and 14-7-7 for pasture land fertilization have accelerated further the interest in suitable formulations for fertilizers of this type.

In the continuous ammoniator pilot plant several different formulations have been tested for 20-10-10 and 16-8-8 grades using various materials to supply the major portion of the nitrogen content. Among these materials were ammonium sulfate, solid ammonium nitrate, 83% ammonium nitrate solution, and TVA-produced 30-10-0. Data from some of these tests are shown in the table.

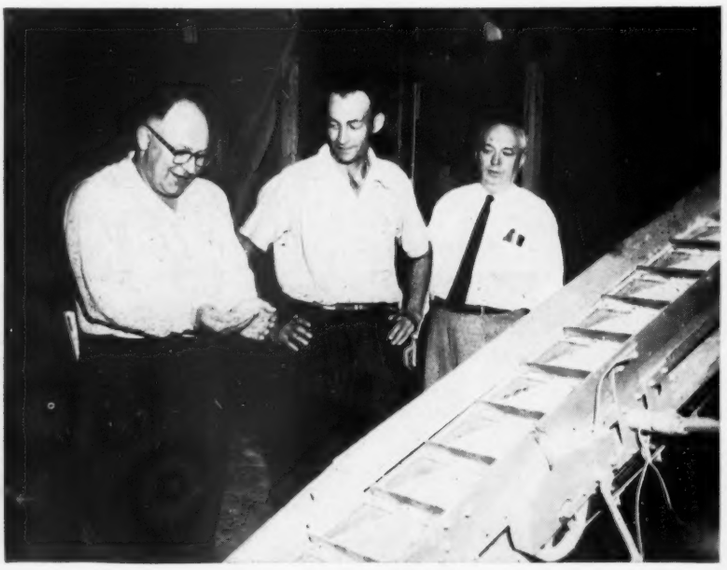
A 30-10-0 ammonium phosphate nitrate has been produced in demonstration-scale equipment by TVA during the past year. It is made by granulating wet ammonium nitrate crystals with phosphoric acid and anhydrous ammonia in a rotary drum. The product is dried to about 0.3% moisture, screened at minus 6 plus 16 mesh, and coated with a conditioning agent. It is shipped either in bags or in bulk and is available in limited tonnages to fertilizer manufacturers for trial use in mixtures at $58 per ton, bulk, f.o.b. Sheffield, Alabama.

While 30-10-0 is produced primarily for bulk blending and direct application, it is well suited as a raw material for the production of inverse ratio grades. It does not add heat and moisture to the formulation; it is a higher analysis source of nitrogen than ammonium sulfate, and it has better bulk-handling properties than solid ammonium nitrate. Also, it provides a high analysis source for part of the P_2O_5 requirements.

Pilot-plant tests have been made using 30-10-0 to supply about 18 units of nitrogen in the production of 20-10-10. The balance of the nitrogen was supplied as anhydrous ammonia or nitrogen solution.

Typical data obtained when ammonia was the supplementary nitrogen source are shown in test 1 in the table. The other ingredients were ordinary and triple superphosphate, nongranular potassium chloride, and sulfuric acid. A small amount of water needed to pro-

THEY CAME, THEY SAW, THEY CONCURRED—More than 400 representatives of the plant food producing industry were on hand at the recent pilot plant demonstrations of TVA, Wilson Dam, Ala., in June. Pictures on these two pages attest to the degree of attentiveness accorded the various displays and working pilot plants. Top photo, page 4, shows general view of visitors swarming over granulation unit producing about four tons a day of a 20-10-10 product. The next two photos show closer-up views of the granulation unit and the visitors inspecting it as well as the finished product being put in



Pilot Plant Work on Fertilizers at TVA

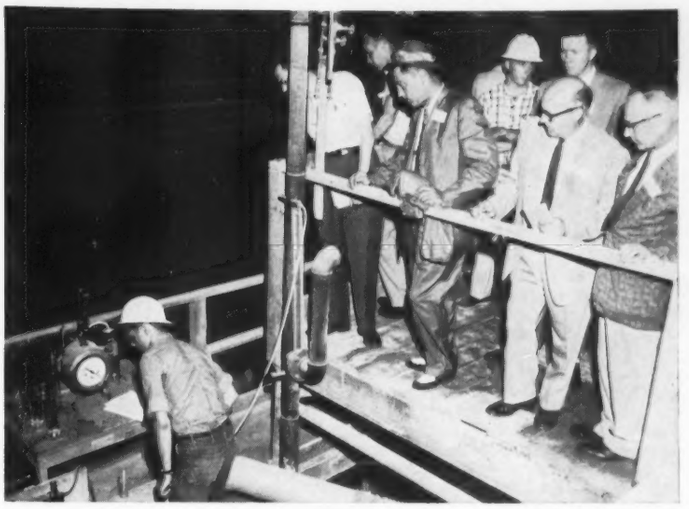


Photo at Right:

LOOKING IN ON PROGRESS—Fertilizer industry representatives watch closely as TVA workman checks gauges in connection with manufacturing granular materials. Inverse ratios, with unusually large nitrogen content, attracted considerable attention at the pilot plant demonstrations.

mote granulation was fed with the ammonia. The recycle rate was 600 lb. a ton, and the ammoniator product temperature was 190° F. The loss of ammonia was moderate, and granulation efficiency was high.

The formulation using nitrogen solution is shown in data from test 2. This formulation probably would be more economical in most locations because it requires no sulfuric acid and about 1.5 units of ordinary superphosphate can be used. This formulation was not satisfactory in the pilot plant without the use of steam to supplement the low heat of reaction. When a small amount of steam was added under the bed in the ammoniator, the results were comparable to those obtained with the formulation that contained anhydrous ammonia and sulfuric acid. In a test in a large-scale ammoniator, no steam was required, however, due presumably to the proportionately lower heat loss from the larger unit.

The 30-10-0 is normally produced with a large portion of the product in 6- to 8-mesh-size fraction. For use in the continuous ammoniator, better results would be obtained by using minus 8-mesh material to minimize the amount of oversize produced when other ingredients are coated on larger particles of 30-10-0.

Pilot-plant tests were made of the production of 16-8-8 using various proportions of ammonium sulfate and ammoniating solution as the source of nitrogen. Other ingredients were ordinary and triple superphosphate, potassium chloride, and sulfuric acid. The amount of ammonium sulfate was varied from 4 to 10 units to determine the minimum that could be used without requiring excessive recycling rates (1,000 lb./ton or less). About 8.5 units of ammonium sulfate was the minimum requirement for operation without excessive agglomeration. Data obtained when using this amount of solution are shown as test 3. Use of one of the low-moisture (6 to 7% H_2O) ammoniating solutions probably would reduce the amount of ammonium sulfate required and thereby reduce the cost of the formulation.

A formulation for 20-10-10 which utilized 14 units of nitrogen as granular ammonium nitrate was tested (test 4 in Table II) in the pilot plant. It is believed that prilled ammonium nitrate would give

TABLE II

Data for Pilot-Plant Tests in Production of Granular 2:1:1 Ratio Fertilizers

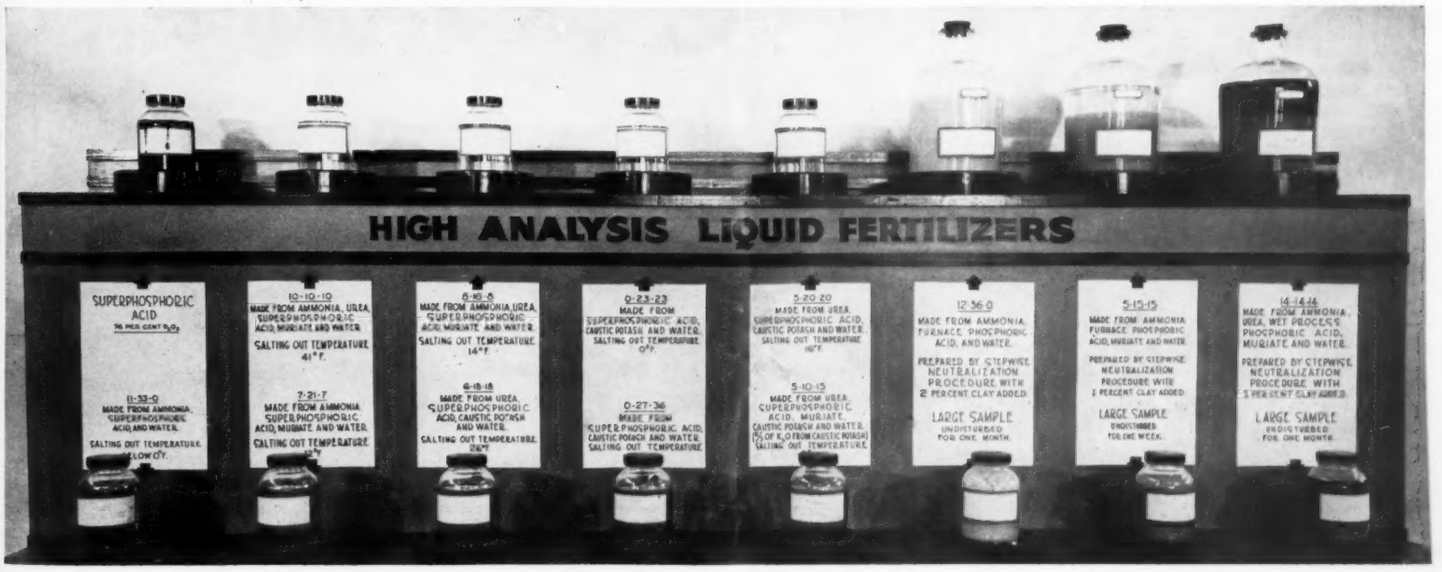
Grade	20-10-10		16-8-8	20-10-10	
Major source of nitrogen	30-10-0	30-10-0	Ammonium sulfate	Ammonium nitrate Solid	Ammonium nitrate Solution
Test No.	1	2	3	4	5
Production rate, tons/hr.	2	2	2	2	0.5
Formulation, lb./ton of product					
Anhydrous ammonia	60	0	0	0	43
Ammoniating solution[a]	0	98(X)	383(X)	288(X-6)	0
Ammonium nitrate	0	0	0	848[c]	1337[d]
Ammonium sulfate	0	0	869	0	0
30-10-0	1233	1194	0	0	0
Ordinary superphosphate	133	401	54	0	0
Triple superphosphate[b]	128	0	322	440	495
Potassium chloride	338	329	272	338	358
Sulfuric acid (93% H_2SO_4)	122	0	166	106	0
Water	30	0	0	15	0
Steam	0	54	0	0	0
Recycle	608	390	404	466	4320
Air, cu. ft./ton of product	0	0	6000	0	6360
Lb. NH_3 fed/unit of available P_2O_5	4.8	5.7	3.5	3.5	3.6
Moisture, %					
Input to ammoniator	2.0	4.1	3.0	2.0	4.0
Ammoniator product	1.7	2.4	1.5	2.2	3.2
Screened product	0.4	1.0	0.4	0.6	0.3
Temperature, °F.					
Ammoniator	189	129	201	191	148
Dryer	202	191	200	215	219
Loss, %					
Free NH_3, by gas analysis	2	2	6	5	10
P_2O_5 availability in superphosphate	0.5	0	0.3	0.7	1.6
Screen analysis of dryer product, %					
Oversize (+6 mesh)	34.7	30.7	23.5	62.6	34.5
Onsize (-6 +16 mesh)	58.0	51.3	60.2	35.3	62.4
Undersize (-16 mesh)	7.3	18.0	16.3	2.1	3.1
Onsize material after crushing oversize, %	79	70	78	73	83

[a]

Solution[c]	Composition, % NH_3	NH_4NO_3	H_2O
X	22.2	65.0	12.8
X-6	25.0	69.0	6.0

[b] Material (48 to 49% A.P.A.) made from electric furnace phosphoric acid.
[c] Granular.
[d] 83 per cent ammonium nitrate.

wheelbarrows. Lower photo indicates interest on part of observers in watching output of liquid mixes. The six pipes running into the drum are connected to a squeeze pump. Below is display of high analysis liquid fertilizer products with explanatory information by each. Note the 14-14-14 sample at right end of stand. It had been undisturbed for a month, according to the information given on the card. If the reader was present at the pilot plant demonstration, a close look at the different groups might reveal yourself peering eagerly at the displays. Look carefully, now!


HIGH ANALYSIS LIQUID FERTILIZERS
SUPERPHOSPHORIC ACID
76 PER CENT P_2O_5
11-33-0
MADE FROM AMMONIA, SUPERPHOSPHORIC ACID AND WATER.
SALTING OUT TEMPERATURE
LOW CY.
10-10-10
MADE FROM AMMONIA, UREA, SUPERPHOSPHORIC ACID, MURIATE AND WATER.
SALTING OUT TEMPERATURE
41°F.
7-21-7
MADE FROM AMMONIA SUPERPHOSPHORIC ACID, MURIATE AND WATER.
SALTING OUT TEMPERATURE
6-18-6
MADE FROM AMMONIA UREA, SUPERPHOSPHORIC ACID, MURIATE, AND WATER.
SALTING OUT TEMPERATURE
14°F.
6-18-18
MADE FROM UREA, SUPERPHOSPHORIC ACID, CAUSTIC POTASH AND WATER.
SALTING OUT TEMPERATURE
0-23-23
MADE FROM SUPERPHOSPHORIC ACID, CAUSTIC POTASH AND WATER.
SALTING OUT TEMPERATURE
0°F.
0-27-36
MADE FROM SUPERPHOSPHORIC ACID, CAUSTIC POTASH AND WATER.
SALTING OUT TEMPERATURE
5-20-20
MADE FROM UREA, SUPERPHOSPHORIC ACID, CAUSTIC POTASH AND WATER.
SALTING OUT TEMPERATURE
10°F.
5-10-15
MADE FROM UREA, SUPERPHOSPHORIC ACID, MURIATE, CAUSTIC POTASH AND WATER. 75% OF K_2O FROM CAUSTIC POTASH.
SALTING OUT TEMPERATURE
12-36-0
MADE FROM AMMONIA, FURNACE PHOSPHORIC ACID AND WATER.
PREPARED BY STEPWISE NEUTRALIZATION PROCEDURE WITH 2 PERCENT CLAY ADDED.
LARGE SAMPLE
UNDISTURBED FOR ONE MONTH.
5-15-15
MADE FROM AMMONIA FURNACE PHOSPHORIC ACID, MURIATE AND WATER.
PREPARED BY STEPWISE NEUTRALIZATION PROCEDURE WITH 2 PERCENT CLAY ADDED.
LARGE SAMPLE
UNDISTURBED FOR ONE WEEK.
14-14-14
MADE FROM AMMONIA, UREA, WET PROCESS PHOSPHORIC ACID, MURIATE AND WATER.
PREPARED BY STEPWISE NEUTRALIZATION PROCEDURE WITH 2 PERCENT CLAY ADDED.
LARGE SAMPLE
UNDISTURBED FOR ONE MONTH.

similar results. Other raw materials were ammoniating solution X-6, triple superphosphate, nongranular potassium chloride, and sulfuric acid. A small amount of water (15 lb./ton of product) was used to promote bonding of the fine particles to the granular material. The granules of ammonium nitrate used in this test were 67% plus 10 mesh in size, and the bonding of other ingredients to them resulted in the production of a considerable amount of plus 6-mesh material. It is believed that a higher proportion of onsize product could be produced by using ammonium nitrate granules of smaller size.

Data for a test in which 83% ammonium nitrate solution was used to supply 18 units of nitrogen are shown as test 5 in Table II. The remaining 2 units of nitrogen were supplied as anhydrous liquid ammonia. There was room in the formulation for about 1.5 units of ordinary superphosphate; however, for convenience, only triple superphosphate was used. No acid was used. The ammonia and ammonium nitrate solution were fed through a common distributor that extended over the full length of the ammoniator.

The large amount of liquid phase in the formulation made it necessary to use a high rate of recycle (4320 lb./ton of product) to obtain satisfactory granulation. A fairly high rate of cooling air also was used in the drum. Without air for cooling, a still higher rate of recycle probably would be necessary. Also, the use of ammonium nitrate solution would require special facilities that are not available in most plants since it must be kept hot to avoid crystallization. For these reasons, formulation with ammonium nitrate solution does not appear to be attractive.

Tests were made to evaluate the bag- and bulk-storage properties of the 16-8-8 and 20-10-10 grades produced in the pilot plant. The products were stored in six-ply paper bags having two asphalt-laminated plies. Test bags were placed in the bottom four positions in a stack twelve bags high. The moisture content of the material as stored ranged from 0.3 to 0.8%.

When the 20-10-10 products had been conditioned with 2.5% kaolin or Celite, little or no bag set occurred during 1 to 3 months of storage. There were no lumps present after the standard drop test. Unconditioned products of 20-10-10 had only a light bag set after 1 month of storage. No advantage was noted in curing the products prior to bagging.

When the 16-8-8 product had been cured 1 week and conditioned, a medium bag set occurred during 1 month of storage, but there were no lumps after the drop test. Without prior curing, the bag set was hard, but there were no lumps after the drops. The condition of the material was the same after 3 months of storage. We believe that the combination of ammonium nitrate and ammonium sulfate may have caused the increased bag set in the 16-8-8 grade.

Several of the 20-10-10 products with and without the addition of a coating agent were stored in open piles for 1 to 4 weeks. During humid periods a moist layer ½ to 1 inch thick formed on the surface of the pile. During less humid periods this layer would become dry and would cake lightly. The material beneath this layer was in good condition. These materials should store satisfactorily in bulk if precautions are taken to reduce the exposed surface area although early bagging would be preferable.

The use of 30-10-0 ammonium phosphate nitrate to supply 18 units of nitrogen in production of granular 20-10-10 have been demonstrated in the pilot plant. The formulation is given in the table below:

Raw material	Analysis	Pounds per ton of product
30-10-0	30% N, 10% P_2O_5	1173
Anhydrous liquid ammonia	82.3% N	60
Sulfuric acid	93% H_2SO_4	128
Ordinary superphosphate	20% P_2O_5	125
Triple superphosphate	46% P_2O_5	130
Potassium chloride (nongranular)	62% K_2O	323
Conditioner		50

Tests Made with Wet Process Acid in Liquid Fertilizers*

EXPLORATORY STUDIES have been made by TVA in which liquid fertilizers essentially free of solids were made from highly concentrated wet-process acid. The absence of precipitated solids in the liquid fertilizers was due to the self-sequestering property of the acid which resulted from the presence of nonortho P_2O_5. The nonortho P_2O_5 was formed during the concentration step.

In this work, commercial wet-process acid (51 to 55% P_2O_5) was concentrated by evaporation at atmospheric pressure. Samples of acid from several commercial producers were used. These included acid produced from Florida and western phosphate rock. All of these samples contained a considerable amount of solids. Both continuous and batch tests were made. In the batchwise tests the acid was concentrated in a glass flask, and samples of the concentrated acid were withdrawn periodically.

In the continuous tests the concentrator was a metal tube 1⅜ inches in diameter by 24 inches long. The acid was fed into this through a pipe located near the bottom of the tube, and the strong acid overflowed through a pipe located 4 inches above the bottom. The concentrator was heated on the bottom with a gas flame, and a jet of air was directed into the top to control foaming. The concentrator was operated to produce about 1 liter of concentrated acid per hour.

As the acid was concentrated, some of the P_2O_5 was converted to a nonortho form. It appears likely that the proportion of P_2O_5 converted varies with the composition of the original acid. Data from tests with one sample of acid (from Florida rock) are shown in Figure 1. In these tests, about 10% of the P_2O_5 was in a nonortho form in acid concentrated to about 68% P_2O_5.

It was found that concentrated acid containing 69% or less total P_2O_5 usually was fluid at room temperature. Above 69% the acid was solid or semisolid. Concentrated acid having a P_2O_5 content within the range of 61 to 69% total P_2O_5 contained no crystals and little or no sludge or settled solids. The concentrated acids were opaque, and it was difficult to determine by observation whether much suspended solid was present.

In storage tests, all of the concentrated acids were stable at room temperature for a period of at least one week. No crystallization and very little sludge formation or settling of solids occurred during this period. Acid concentrated to about 68 or 69% P_2O_5 remained stable for over six weeks. Considerable sludge formed within a month in acids of a lower concentration.

In tests of producing liquid fertilizer, acid concentrated to about 68% P_2O_5 was ammoniated batchwise with aqua ammonia to produce 8-24-0 and 9-27-0 grades. The required amount of water was added simultaneously with the aqua ammonia. The temperature of the acid was kept below 175° F. during ammoniation to minimize hydrolysis of the nonortho P_2O_5.

A 5-15-10 grade also was made from the 8-24-0 by adding potassium chloride. These liquid fertilizer grades contained no crystals and only a very small amount of solids after storage at room temperature or at 32° F. for several weeks. The absence of solids in the liquid fertilizers is attributable to the sequestering effect of the nonortho P_2O_5. The 9-27-0 and 5-15-10 grades are higher analysis than can be produced from electric furnace acid having all the P_2O_5 in an ortho form.

The process is still in the early stages of study. Economical ways of carrying out the concentration are being considered. A pilot plant will then be built to obtain data for technical and economic evaluations and to obtain larger quantities for storage. Further tests of using the acid for producing liquid fertilizer will be made and other uses of the highly concentrated acid also will be investigated.

*Paper presented at TVA pilot plant demonstrations, Wilson Dam, Ala., June 10, by M. R. Siegel, applied research branch of TVA.

Fertilizer Safety Training Schools Set for 5 Regions

FIVE REGIONAL training schools for fertilizer plant supervisory personnel will be sponsored by the fertilizer division of the National Safety Council and the National Plant Food Institute in a series beginning in August, according to an announcement made by the fertilizer section. Meeting dates are as follows:

Aug. 12-13, the first training school will be held at Cornell University, Ithaca, N.Y., for fertilizer personnel from 12 northeastern states. This school will be under the direction of S. M. McCargo, personnel supervisor for GLF Soil-Building service, Ithaca. Associate director will be George F. Dietz, safety director for Fertilizer Manufacturing Cooperative, Baltimore, Md.

Aug. 18-19, at the conference rooms of the National Safety Council, Chicago. John E. Smith, Spencer Chemical Co. safety director, Pittsburgh, Kan., will be director. Associate director will be Roger Hugg, International Minerals & Chemical Corp., Chicago. This school will be held for fertilizer personnel throughout the midwestern states.

Aug. 27-28, the southeastern states meeting will be held at the Heart of Atlanta Motel, Atlanta, under the direction of Quentin S. Lee, Cotton Producers Assn., Atlanta. Associate director will be W. A. Stone, plant manager of Wilson & Toomer Fertilizer Co., Jacksonville, Fla.

Nov. 5-6, far west training school at Fresno, Cal., under the direction of O. J. Chinnock, technical representative of Hercules Powder Co., Hercules, Cal. Assistant director will be Austin R. Cline, Shell Chemical Corp., San Francisco.

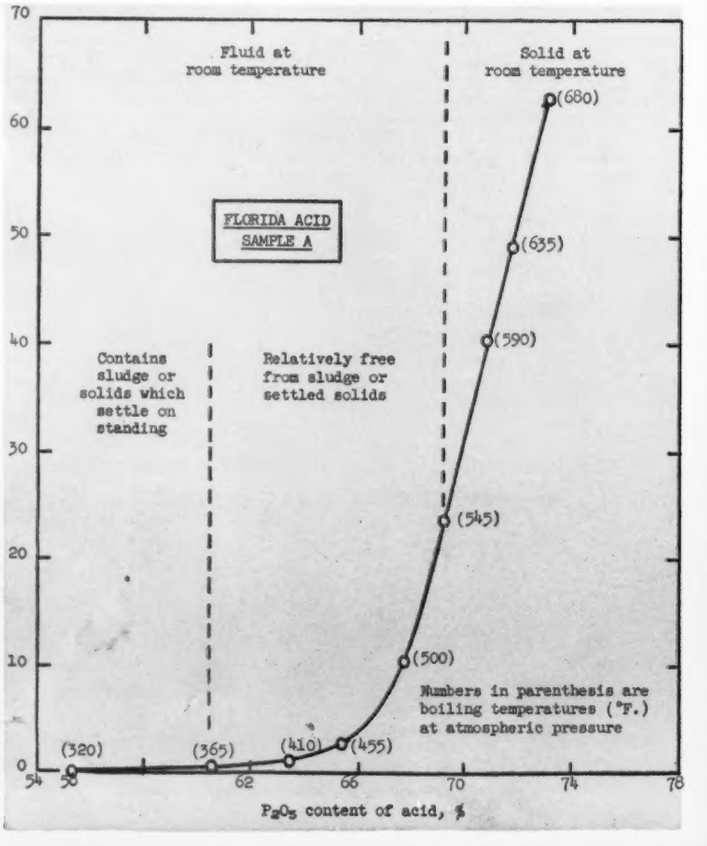
Nov. 12-13, will see the southwestern school being held at Houston, Texas with A. I. Raney, Phillips Chemical Co., Bartlesville, Okla., as director. Associate director will be Horace Kelly, Olin Mathieson Chemical Corp., Little Rock, Ark.

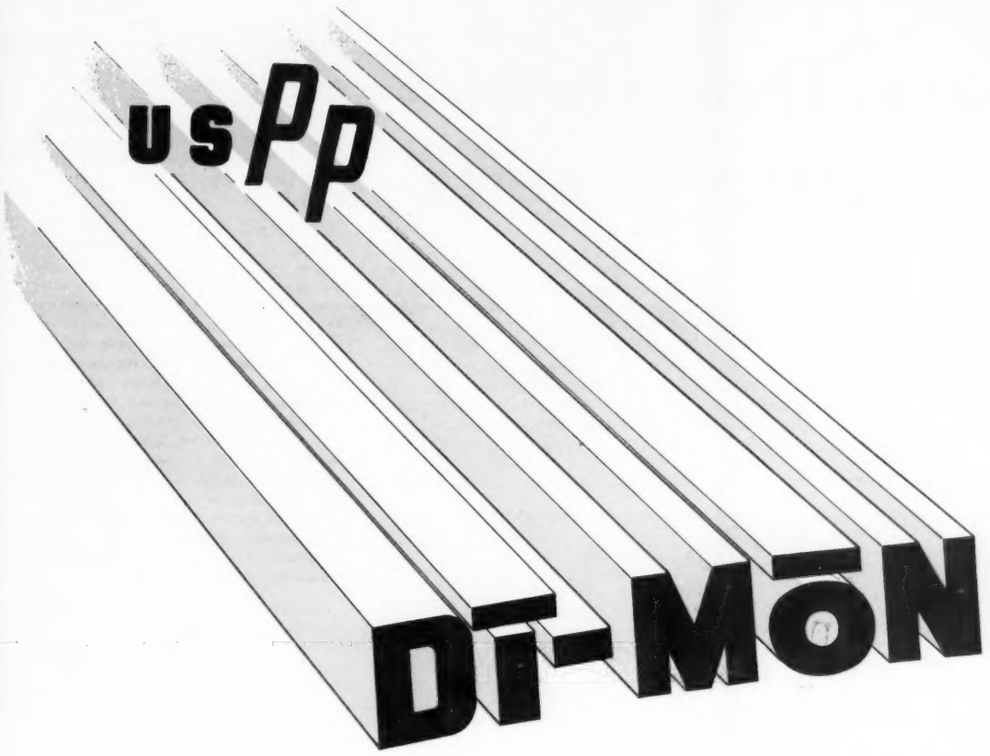
The first school at Cornell University, Aug. 12-13, will include speakers from the industry, representatives of insurance firms, and state officials.

Appearing on the program will be W. C. Creel, North Carolina Department of Labor, Raleigh, N.C., speaking on "Personal Safety"; Elmer Perrine, Nitrogen Division, Allied Chemical Corp., New York, on "Handling Liquid Materials"; Ed O. Burroughs, Jr., F. S. Royster Guano Co., Norfolk, Va., on "Maintaining Good Order for Safety"; Everett Martin, Liberty Mutual Insurance Co.; Robert F. Risley, New York State School of Industrial and Labor Relations, and Prof. Harlan Perrins, of the same school.

Panel discussions will be held, with plenty of opportunity for participation from the floor by those attending the meeting. There will also be small group discussions and other exchanges of ideas and safety experiences.

Figure 1
Concentration of Wet-Process Phosphoric Acid by Evaporation





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Liquid Fertilizer Facilities On the Increase Throughout U.S., TVA Spokesman Reports*

THE LIQUID mixed fertilizer industry, which began in the Far West, has now spread to all parts of the country and in some areas accounts for a significant portion of fertilizer consumption. The growth has been affected to some extent by problems peculiar to liquid forms of fertilizer. Progress is being made toward solving or minimizing these problems and thereby gaining full benefit from the inherent advantages of the liquid form. This paper reviews progress on the problems and summarizes the status of liquid fertilizer technology of the past two years.

A 1957 review gave 167 as the approximate number of liquid mix plants in this country; today there appear to be more than 300. The approximate location of these plants is shown in the accompanying map. While all available sources of information were used in making up this map, several plants probably have been omitted or entered incorrectly. In such a fast-growing industry it is difficult to get complete information on the current situation.

Current production is even more difficult to estimate. Several plants are operating at an annual production rate of more than 5,000 tons, but the average is considerably lower than that, probably in the 1,500- to 2,500-ton range. On this basis, production this year would be in the range of 450,000 to 750,000 tons. An estimate made on a different basis—estimated amount of raw materials going into liquid mixed fertilizer production—gives a figure of 500,000 tons for 1958. These values indicate that 3 to 5% of the mixed fertilizer being produced currently is in the liquid form.

The preferred type of plant appears to be the semicontinuous type, that is, phosphoric acid and ammonia (or solution containing free ammonia) are fed concurrently to a reaction vessel to make up a batch of solution. Minor adjustment of composition can be made after all the constituents are added. The reaction vessel is usually a small stainless steel chamber or pipe section, from which the neutralized solution flows into a mild steel batch tank. In some instances the reaction chamber is placed inside the batch tank. Recirculation of solution through a cooler and through the reaction chamber is common practice.

Another type of plant which is growing in popularity is a simple blending, or "cold mixing," type. No reaction vessel is required, since the phosphatic raw material used is purchased in a neutralized form. The main items of equipment needed are meters, feeders, and a mixing tank. One of the main problems in operating this type of plant is the cooling effect resulting from dissolution of salts. There is no heat of reaction to offset this as there is in neutralization plants. As a result cooling of the solution may slow down dissolution of salts to the point that production rate is seriously reduced.

Mild steel is generally accepted as the construction material for all equipment except the reaction chamber and acid-handling equipment. The main trouble with mild steel appears to be rusting in storage and application equipment, with consequent stoppage difficulty in application. Aluminum equipment is used by some, especially when ammoniating solutions are also handled, but the consensus seems to be that aluminum should be avoided in the handling of liquid mixes.

Furnace-type phosphoric acid is still the main source of phosphate, although wet-process acid is being used in a few plants. Cold-mixing plants, which are few in number, use ammonium phosphate solution or solid diammonium phosphate.

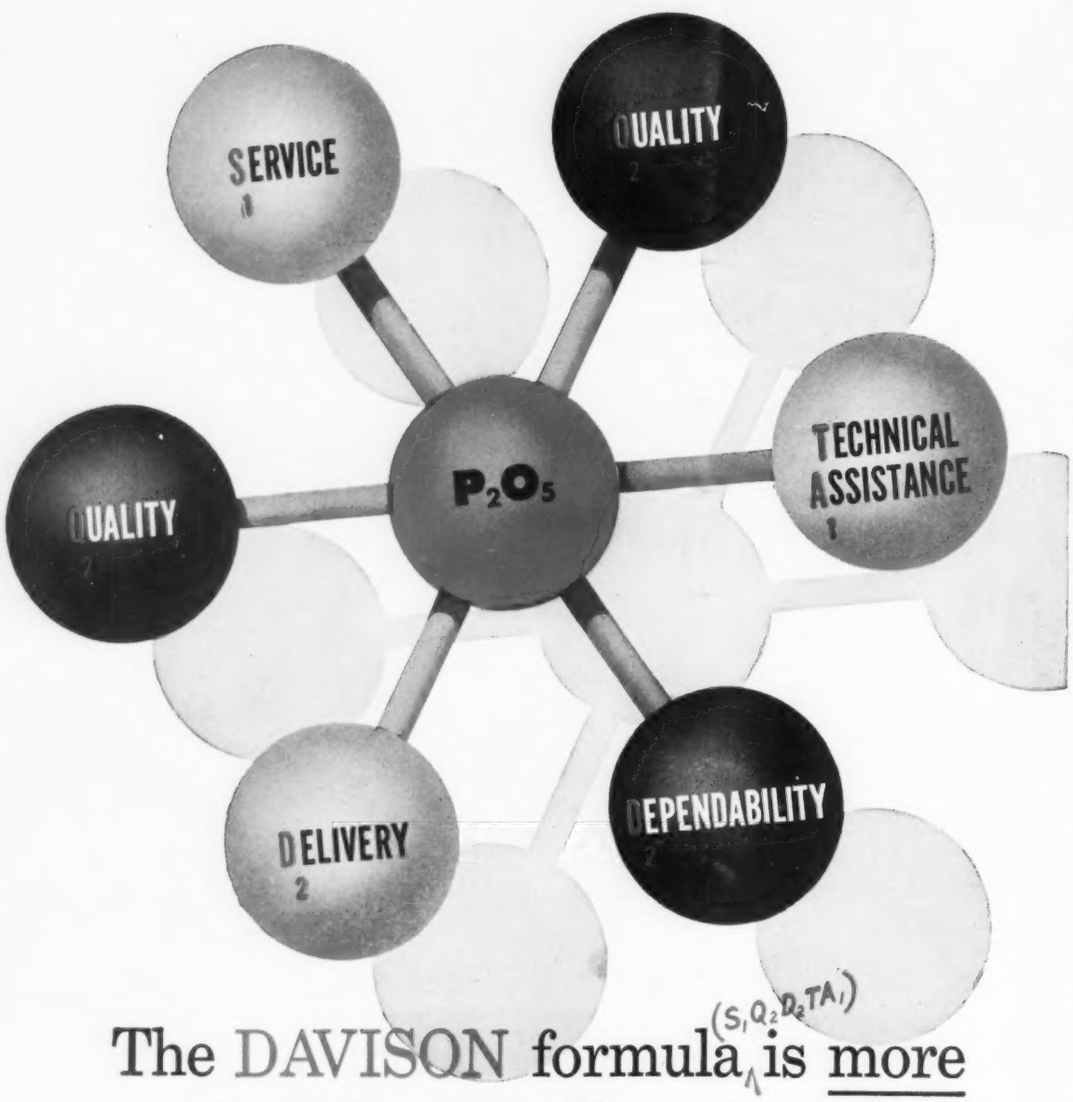
Urea-ammonium nitrate solution appears to be the principal source of nitrogen for supplementing the ammonia required to neutralize the acid. Urea and various ammoniating solutions are also used, and in the Far West ammonium nitrate continues to be a leading source of supplemental nitrogen.

Practically all the potash is supplied as potassium chloride. However, limited use of potassium hydroxide has been noted recently, mainly to reduce the chloride content in tobacco fertilizers.

Supplies of all raw materials seem adequate with the exception of phosphoric acid. It is reported that the supply of both furnace and wet-process acid has been limited during the current production season, especially in the Midwest. The acid is in such demand in the solid fertilizer industry for use in granulation that production and shipping facilities have not been adequate to meet the needs of all consumers.

A continuing problem is the relatively low analysis attainable in liquid mixes as compared to solid mixes. Coupled with this is the lack of good

*Paper presented by Archie V. Slack, Tennessee Valley Authority, at TVA pilot plant demonstration, Wilson Dam, Ala., June 10, 1959.



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data on what grades can be made with available materials.

Considerable progress has been made on the latter problem. Work has been done by the Monsanto Chemical Co. and Sohio Chemical Co. in determining the solubility of specific grades or nutrient ratios. The Sohio work also included a study of the effect on solubility resulting from varying the ratio of urea to ammonium nitrate in the supplemental nitrogen. In work at TVA, a method has been worked out whereby the maximum grade stable at 32° F. can be estimated for any nutrient ratio. Also, by use of a formula developed in this work salting-out temperature for particular grades can be estimated.

Although progress has been made, more data are needed on solubility in liquid mixed fertilizer systems. Some information is available on solutions made with diammonium phosphate or from superphosphoric acid but more is needed. Little or no information has been available on solutions in which part or all of the potassium chloride is replaced with potassium hydroxide. Liquid fertilizers of this type are being studied at TVA.

Progress is also being made toward increasing the nutrient content of liquid mixed fertilizers. The various approaches and the status of each are summarized as follows:

1. Urea has been regarded as the best source of supplemental nitrogen as far as solubility is concerned. Work by Sohio has shown that use of ammonium nitrate along with the urea raises the grade for some nutrient ratios. The optimum amount varies with the ratio. In many instances, however, addition of ammonium nitrate reduces solubility.

2. The NH_3:H_3PO_4 ratio has a significant effect on solubility in grades low in potash. General practice is to use a mole ratio of 1.7 whereas 1.6 or 1.5 usually gives a somewhat higher grade. A few producers are taking advantage of this.

3. Use of superphosphoric acid (76% P_2O_5) gives a large increase in solubility, especially in grades low in potash. Several producers are using superphosphoric acid this season. An 11-33-0 base solution made from superphosphoric acid is also being used to some extent in cold-mix operations.

4. For grades containing potash, solubility can be increased by using potassium hydroxide or potassium carbonate rather than potassium chloride. However, these materials are so much more costly than potassium chloride that use of them merely to increase concentration is quite limited.

5. Concentration can be increased by exceeding the solubility of the nutrient salts and treating the salted out constituents to produce a stable suspension. Salting out is then no longer a major difficulty but problems in applying the product are introduced. Very high grades can be produced in this manner but much more work is needed before the practicality of the method is established and producers can use it with any assurance of success. However, successful production and application of a salt suspension have been reported.

In addition to the problem of limited concentration, liquid fertilizer producers are not able to make some of the popular nutrient ratios because of their high acidity. Examples of these are 1:4:4, 1:6:6, 1:4:2, and 0:1:1. Such ratios can be made by replacing part or all of the potassium chloride with potassium hydroxide.

Special grades also give trouble in liquid fertilizer production. Tobacco grades, for example, require use of nonchloride potash in the formulation. Potassium hydroxide is useful for this purpose in liquid fertilizers since it gives higher solubility than does the potassium sulfate ordinarily used in solid fertilizers. Solubilities for this system have also been determined at TVA. Use of potassium hydroxide in tobacco fertilizers has been reported.

Some fertilizers contain insoluble constituents such as magnesium compounds or water-insoluble nitrogen. The suspension technique has been found useful for preparing such fertilizers in fluid form.

Process Economics

One of the main advantages of the liquid route to fertilizer production is the relatively low investment required for plant equipment. Elimination of operations such as granulation, curing, fume disposal, and bagging simplifies production considerably. However, many producers have found it necessary to invest heavily

Approximate Location of Liquid Mixed Fertilizer Plants in 1959

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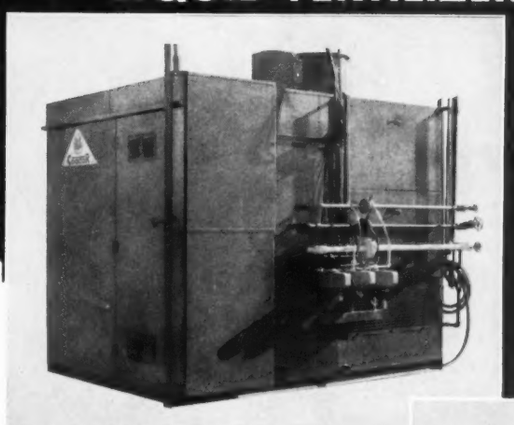

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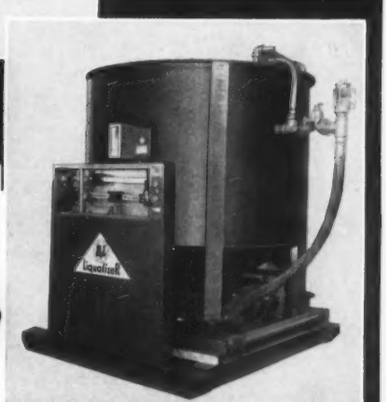

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Designed specifically for converting standard batch operated plants to the proven continuous ammoniation process.

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Ultimate in batch-type "complete package" units. Features the fully automatic continuous acid neutralization process.

in distribution and application equipment in order to sell their product. Thus the total investment can be considerable—reportedly over $200,000 in some instances. This problem is minimized as farmers obtain their own application equipment or custom applicators set up to do business in an area.

The liquid fertilizer producer is usually in good position as far as costs for operating labor, maintenance, and depreciation are concerned. However, raw material cost is an important problem.

The trend is toward using urea-ammonium nitrate solution rather than urea as a means of reducing cost for supplemental nitrogen, even though the grade is usually lowered thereby. The main raw material cost problem, however, is in regard to phosphate. The lower cost of wet-process acid in most areas has led to a major effort in finding ways to use it. The various efforts to avoid the problem brought about by the impurities in wet-process acid can be grouped under the following headings.

1. Purifying of acid. The problem can be minimized by giving some attention to the purity of the acid at the producing point. Some producers now do this, either by extended settling or by chemical additions to precipitate some impurities. However, the major impurities—iron and aluminum—are not removed by these procedures.

2. Precipitation of impurities. The iron and aluminum precipitate upon the ammoniation of the acid and can then be removed by filtering, decantation, or other separation methods. The precipitate, however, contains part of the phosphate and must be recovered and used. For a producer making only liquid mixed fertilizer this is a difficult problem. For this reason the method is more applicable to plants that also produce a solid NP or NPK fertilizer, into which the settled sludge or filter cake from the acid ammoniation step can be incorporated.

This method is in use, mainly in the Pacific Northwest. There most of the liquid mixers use a base 8-24-0 solution supplied by an acid producer. Except for shipping cost, this appears to be a good way of using wet-process acid in liquid mixed fertilizers.

3. Sequestration of impurities. Since the producer of liquid mixes normally has no good way to handle separated impurities, he must leave them in and try to find some way to get an acceptable product. One approach is to add a sequestering agent that will prevent the impurities from precipitating when the acid is ammoniated. There are several agents which will do this but most of them are too expensive. The only one that appears promising is superphosphoric acid; the

Turn to **LIQUIDS** page 12

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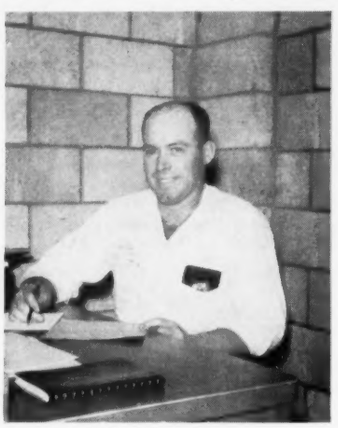
PRODUCTION Man of the Month

PLANTERS CHEMICAL CORP., Norfolk, Va., is proud of its pesticide production man, Norman R. Smith. To find backing for this statement one has only to glance at the comments made by George Simches,



Norman R. Smith

vice president of the firm, in describing the work done by Mr. Smith. "We consider him to be one of the outstanding men in our organization and are very proud, indeed, of the way he takes care of his many responsibilities in operating our plant here in Norfolk," Mr. Simches says.

Mr. Smith did not arrive at his present position of plant superintendent in one single jump. Actually, he started as a plant trainee at Planters Chemical in 1951 when the firm's operation consisted almost entirely of the blending of finished dusts from concentrates.

"Since that time," Mr. Simches says, "Mr. Smith has seen the transition from merely dry blending to the handling of all types of technical pesticides into finished formulations, granular, dry powder, or liquid, by grinding, impregnating, or by dissolving in various solvents.

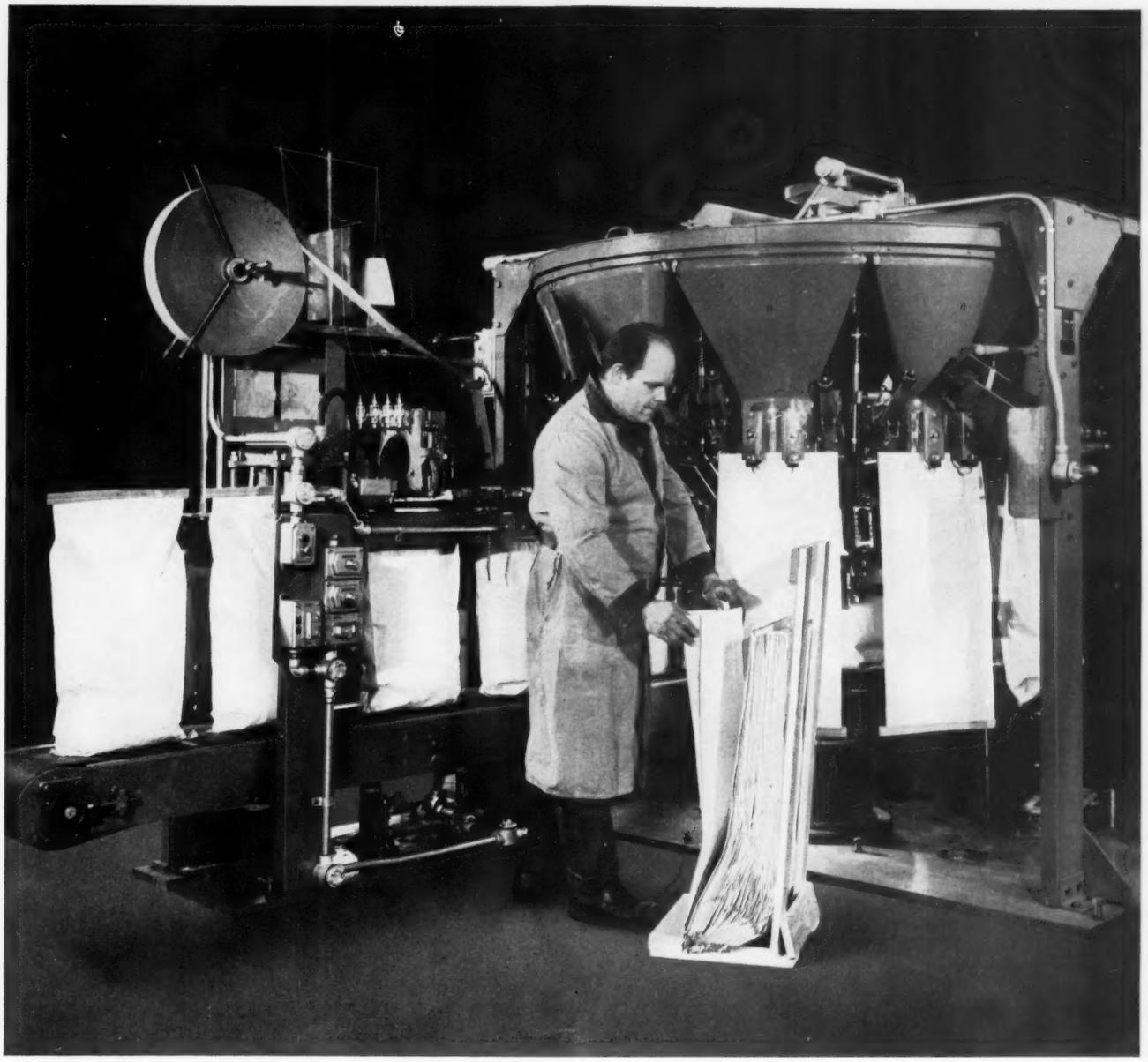
"Although not an engineer by training, Mr. Smith has an uncanny knack and know-how when it comes to working with machinery, and only the major repair jobs are contracted for on the outside, with the multitude of general maintenance and small repair jobs being taken care of under his supervision.

"Mr. Smith was born in Norfolk County, Virginia, on April 15, 1928, and was graduated from Great Bridge High School, Great Bridge, Virginia. He attended Wingate College, Wingate, North Carolina, for several years. He is married and has two daughters, ages seven and two. His hobbies are camping, fishing and hunting, all of which, of necessity, he cannot do very much justice to until after the 'busy season' is over."

New Supply Firm Formed in Arkansas

LITTLE ROCK, ARK. — Farmers Supply & Chemical Co., Texarkana, Ark., has filed articles of incorporation with the Arkansas secretary of state's office here.

Ths firm, which was formed to operate a general farm supply business, was authorized 250 shares of $100 stock. Incorporators are B. J. McCoy, D. A. Roberson and S. A. Mason, all of Texarkana, Ark. Joe Rosenbloom of Texarkana was named as the corporation's agent.



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Bagpak Division **INTERNATIONAL PAPER** New York 17, N. Y.

Safety Training of Inexperienced Men for Part-time Work Troublesome but Necessary

By Curtis A. Cox

Manager, Manufacturing Department Virginia-Carolina Chemical Corp., and past chairman of Fertilizer Safety Section, National Safety Council.

Curtis A. Cox

The heavy influx of seasonal workers in the fertilizer industry puts an acute safety problem in the laps of management.

The short, high-peak plant activity creates an immediate demand for manpower, but makes many of the normal safety precautions relatively inoperative. Normal selection processes are compromised in the all-out effort to bring in enough manpower to meet the production schedules. Companies cannot be sure that the new employees hired under pressure weren't someone else's accident problems.

Add to this the fact that many of the employees hired during heavy shipping are totally inexperienced in any kind of plant work. They have never had an opportunity to develop good safety habits, and they are blind to many of the plant hazards. Hence, companies are faced with potentially high accident frequency and production inefficiencies.

The V-C management is in the same boat with other manufacturers. We don't have time for individual safety indoctrinations for seasonal employees. We have to press men into production as quickly as possible.

Yet, we don't let the problem go unattended. In fact, we are aware of it during all twelve months of the year. The safety program developed for our regular employees encompasses employee training in operations as well as safety. We believe that an employee who has received this kind of instruction will be able to assist the seasonal employee more adequately and help him adapt himself more quickly to his new job. Of course, the sooner the new man has mastered the proper technique in handling his duties, the sooner the inherent safety problems are removed.

Our safety program revolves around twelve monthly meetings a year. These meetings are set up with a program prepared in advance and designed to hit at a special problem area.

Since the inauguration of this program, there has been a decided decrease in the number of accidents, particularly in the heavy shipping period when normally the accident rate is usually highest.

The net result is less accidents, greater efficiency in production, and lowered compensation rates.

Anhydrous Ammonia Rail Freight Rates Reduced

WASHINGTON—The reduced railway freight rates on anhydrous ammonia which have been in effect on a temporary basis since April 1, 1958, between points east of the Rocky Mountains, was authorized recently by the Interstate Commerce Commission. In its action, the ICC confirmed that the lower rates are reasonably compensatory and justified.

The new ICC order required the carriers to set rates on anhydrous ammonia traffic over long hauls at levels less than the total of the rates for intermediate points.

When the new rates were first proposed, more than a year ago, the National Tank Truck Carriers, Inc., objected, but their protest was not pressed during the subsequent investigation by ICC.

Affected by the new order are tankcar loads from, to, and between points in southwestern, western trunkline, Illinois, southern territories and adjacent points.

Monsanto Advances Price Of Phosphatic Solutions

ST. LOUIS, MO.—An increase of $3 a ton on its phosphatic fertilizer solutions has been announced by the inorganic chemicals division of Monsanto Chemical Co. The new rates became effective July 1. This brings the price (based on 75% phosphoric acid content) to $88 a ton, f.o.b. plant, with freight equalized with the nearest producing point. According to Monsanto, the reasons for the price hike involved higher costs of labor and raw materials.

Use of Caustic Potash and Superphosphoric Acid to Make Liquid Fertilizer Products*

THE RELATIVELY low nutrient content of liquid fertilizers resulting from limited solubility of raw materials is a factor which has tended to hinder the popularity of this form of plant food. However, greater solubility has been obtained by substituting superphosphoric acid for orthophosphoric acid, and further increases may be obtained by substituting potassium hydroxide for potassium chloride.

Cost factors have been a consideration in the use of potassium hydroxide, but it appears that there may be special situations, especially for crops which need low-chlorine fertilizers, where the use of potassium hydroxide is justified economically. Potassium sulfate, which is commonly used in low-chlorine solid fertilizers, has not been sufficiently soluble for use in liquid fertilizers.

Experimental study of liquid fertilizers based on superphosphoric acid and potassium hydroxide is being carried out. Emphasis is placed on tobacco grades and on ratios such as 0-1-1 and 1-4-4 which do not contain enough nitrogen as ammonia to neutralize the acid present and would therefore be acidic without the use of potassium hydroxide.

Use of potassium hydroxide instead of potassium chloride made possible the production of liquids of higher grades of the same $N:P_2O_5:K_2O$ ratio and lowered the saturation temperatures for the same grades. Maximum grades which did not salt out at 32° F. were 7-14-14, 6-12-18, 6-12-15, 6-18-18, 5-20-20, 0-23-23 and 0-27-36 at the respective ratios of 1:2:2, 1:2:3, 2:4:5, 1:3:3, 1:4:4, 0:1:1, and 0:3:4. The maximum corresponding grades made with potassium chloride are 5-10-10, 3-6-9, and 3-9-9, respectively, for ratios of 1:2:2, 1:2:3 and 1:3:3. For the latter two ratios, nutrient content was doubled by using potassium hydroxide rather than potassium chloride.

The saturation temperature of a 5-10-10 grade solution made with half of the potash from potassium hydroxide and half from potassium chloride was 7° F. A 5-10-15 grade solution made similarly with one-third of the potash from potassium chloride has a saturation temperature of 0° F.

Tests in a 5-gallon reactor in which 0-21-21 and 6-12-18 grade liquid fertilizers were produced for field tests indicated that neutralization of superphosphoric acid with potassium hydroxide is similar to neutralization with ammonia and can be carried out without any particular difficulty.

In making these solutions, superphosphoric acid and potassium hydroxide solution (45%) were added simultaneously to the reactor. The solution was recycled during the neutralization. The tests generally were run for periods of 20 to 30 minutes at a production rate of 10 to 15 gallons an hour.

Work is continuing on determination of solubility for other nutrient ratios and identification of the salts which crystallize when solubility is exceeded. Most of this work is with mixtures of potassium hydroxide and potassium chloride. By using the minimum amount of potassium hydroxide allowable for a particular grade the formulation cost is minimized.

Potassium hydroxide is being used with superphosphoric acid in at least one plant, and probably is being used with orthophosphoric acid in a few others. Some use of byproduct potassium carbonate as a means of reducing formulation cost has been reported. The potassium carbonate should give the same solubilities as obtained with potassium hydroxide.

*Paper presented by J. M. Potts, Applied Research Branch, Tennessee Valley Authority, at TVA pilot plant demonstration, Wilson Dam, Ala., June 10.

Superphosphate Output Increases, Report Says

WASHINGTON — Production of superphosphate and other phosphatic fertilizers for the month of March, 1959, was up some 25% over the same month of the year before. Tonnage for March, 1959 was 265,029 as compared to 228,583 tons for the same month of 1958, according to reports compiled by the U.S. Department of Commerce and released June 1.

Shipments of superphosphate and other phosphatic fertilizers during March totaled 263,880 tons, or an increase of 25% over the volume shipped in March, 1958.

Stocks held by producing plants as of March 31, 1959, totaled 299,942 tons, or 22% less than those held on Feb. 28, 1959, the report said.

For the period of July, 1958, through March, 1959, preliminary totals show that production and shipments of the various grades of superphosphate and other phosphatic fertilizers were all up from the same period of a year ago with the exception of concentrated superphosphate production which was down 3%.

Larry Van Gordon In New Chipman Post

BOUND BROOK, N.J. — Chipman Chemical Co. has announced the appointment of Larry Van Gordon as district manager at Palo Alto, Cal. Mr. Van Gordon succeeds D. A. Zanette who will devote full time to special activities in railroad, industrial and Chlorate sales. Frank Illnick, formerly assistant district manager at Bound Brook, succeeds Mr. Van Gordon as district manager.

New Dow Facility

MIDLAND, MICH.—Purchase of a vacant Findlay, Ohio, industrial plant which will be converted for the manufacture of polyethylene film has been announced by The Dow Chemical Co.

The plant, built in 1947 by National Automotive Fibres, Inc., occupies about 208,000 sq. ft. on a 27-acre site at the Findlay north city limits.

LIQUIDS

Continued from page 10

pyrophosphoric and polyphosphoric acid it contains will sequester impurities as well as supply phosphate to the solution. Work on this method is being carried out by TVA and by several producers.

4. Suspension of impurities. A simple and attractive approach is to allow the impurities to precipitate and suspend them in such a way as to give satisfactory handling and application properties. Considerable work has been done on this method, also, by TVA and by various producers and raw material suppliers. Conditions during the ammoniation step affect the properties of the suspension, and a suspending agent such as a clay has been found helpful in some instances. Some use of wet-process acid by suspending impurities has been reported.

Arcadian® News

Volume 4 — For Manufacturers of Mixed Fertilizers — Number 6

"Thank You!"

"As the rush of the present season ends and preparation for a new fertilizer year begins, all of us here at Nitrogen Division, Allied Chemical, find this an appropriate time to say *'Thank You!'* to our customers. We appreciate your business and trust that you are pleased with our products and our service.

"Every fertilizer year is different—a unique combination of variables. However, one thing in this business is constant—the privilege of building a mutually pleasant and productive relationship with a lot of fine people. We are proud of our customers in the fertilizer industry.

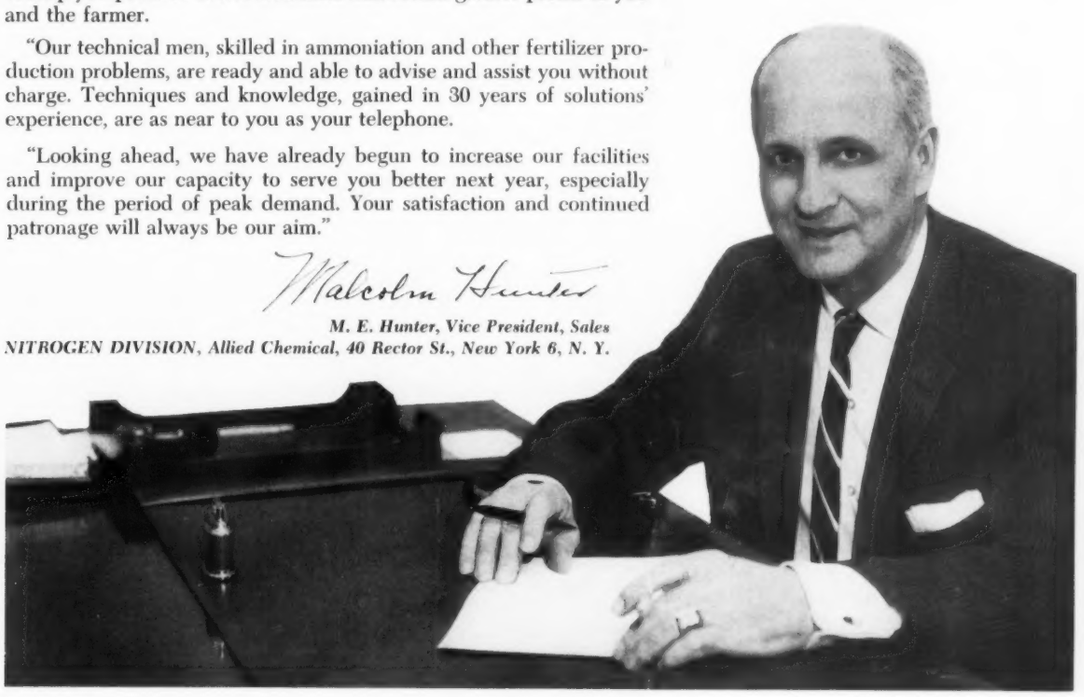
"We strive in many ways to deserve your confidence and your loyalty. We produce for you the most complete line of nitrogen materials for manufacturing fertilizers. The research that originated nitrogen solutions is constantly at work, developing new methods and materials to help you produce better fertilizers that return greater profits to you and the farmer.

"Our technical men, skilled in ammoniation and other fertilizer production problems, are ready and able to advise and assist you without charge. Techniques and knowledge, gained in 30 years of solutions' experience, are as near to you as your telephone.

"Looking ahead, we have already begun to increase our facilities and improve our capacity to serve you better next year, especially during the period of peak demand. Your satisfaction and continued patronage will always be our aim."

Malcolm Hunter

M. E. Hunter, Vice President, Sales
NITROGEN DIVISION, Allied Chemical, 40 Rector St., New York 6, N. Y.



Arcadian News for Fertilizer Manufacturers . . . . . from NITROGEN DIVISION

Hot Weather Handling of Nitrogen Solutions

Producers know the many advantages of using ARCADIAN® Nitrogen Solutions for ammoniation. But it's what they *don't* know about handling these solutions that could cause trouble in the hot weather months ahead.

Boiling points of the various nitrogen solutions will differ—depending largely on their percentage of ammonia *(see thermometer chart)*—but they *all* develop relatively high vapor pressures as temperatures rise. Where this happens, serious problems can occur, such as:

Faulty performance of meters, including the simple, reliable measuring tank. Ammonia gas bubbles, present in a liquid, make meters virtually inoperative, causing inaccurate formulation and confused inventory records.

Incomplete unloading of tank cars. Gas bubbles rushing through unloading lines make the same sounds and jumping motion of the hose as caused by the flow of compressed air when the solution has been completely unloaded. This often misleads operators into thinking that unloading is completed, and they return tank cars partially filled.

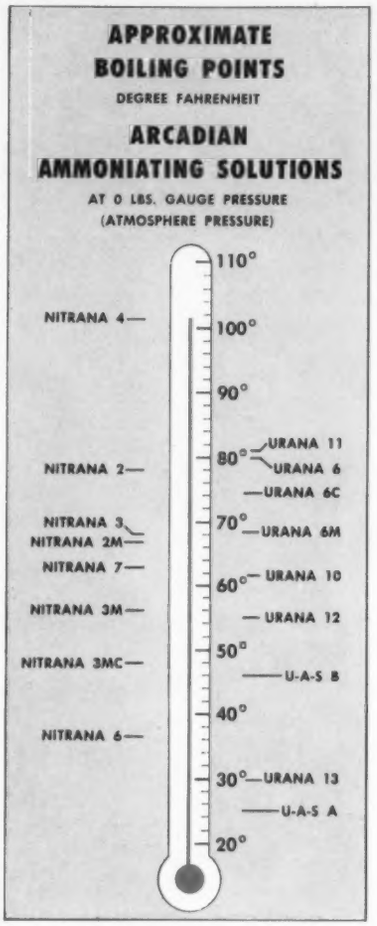
Excessive fumes during operation. The higher the vapor pressure, the greater the possibilities of trouble from ammonia fumes outside the system and from entrained bubbles inside the system.

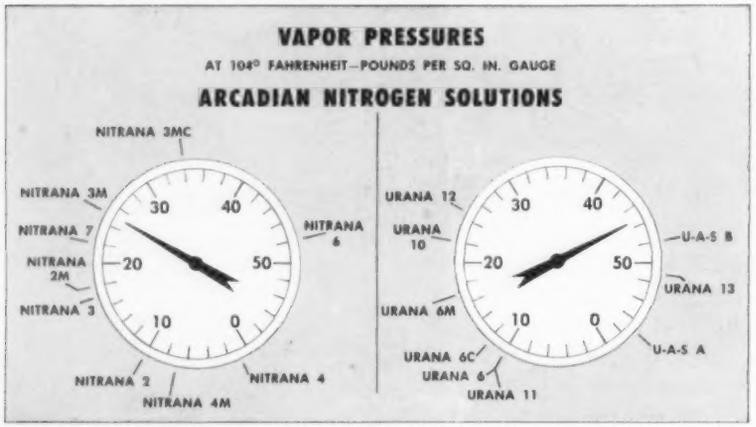
How can the producer tell that excessive vaporization has occurred? In addition to the not-always-reliable practice of "smelling" trouble in heavy fumes, there are accurate visual methods for spotting excessive vaporization. In continuous systems, the alert operator will see tell-tale gas bubbles in the rotometer. In batch systems, the bubbles show in the gauge glass. Where the system uses batch weighing of solution, the experienced operator can detect overly high vapor pressure from the longer period of time it takes to fill the measuring tank.

Excessive vaporization can be minimized to a great extent by taking steps to see that solutions are kept as cool as possible. For example, storage tanks can be shaded from the direct sun. Painting tanks white or aluminum, for heat reflection, also helps. If at all practical, a sprinkler system to spray water on tanks could be installed. In some cases, where the solution is cool when unloaded, insulated tanks would prove valuable.

However, the surest, most effective way to prevent troublesome ammonia gas from forming is to *keep air pressure higher than vapor pressure at all points in the solution handling system.* Of course, the producer must remember that flow resistance in piping and meters can absorb considerable pressure, so that the actual air pressure on the solution at some critical point in the system may be reduced enough to invite troubles from vapor. In fact, the pressure loss in the system could be great enough to permit the release of vapor at some critical point in the system. The wise producer is aware of this and adjusts his air pressure accordingly.

It goes without saying that the producer should check over his equipment and operating procedures *before* putting additional air pressure on his system in hot weather. Tanks and piping should be designed to accommodate the highest anticipated operating pressures. Tanks should be equipped with pressure relief valves to relieve any unexpected pressure build-up. And it is best to have a vacuum relief valve, as well. For where there is a temperature drop, ammonia vapors are reabsorbed by the solution, and a partial vacuum can develop. In hot weather particularly, venting of tanks during transfer of solutions should be held to a minimum, to avoid loss of nitrogen. For more information on hot weather handling of nitrogen solutions in terms of your own operation, contact: Nitrogen Division, Allied Chemical Corporation, 40 Rector Street, New York 6, N. Y.





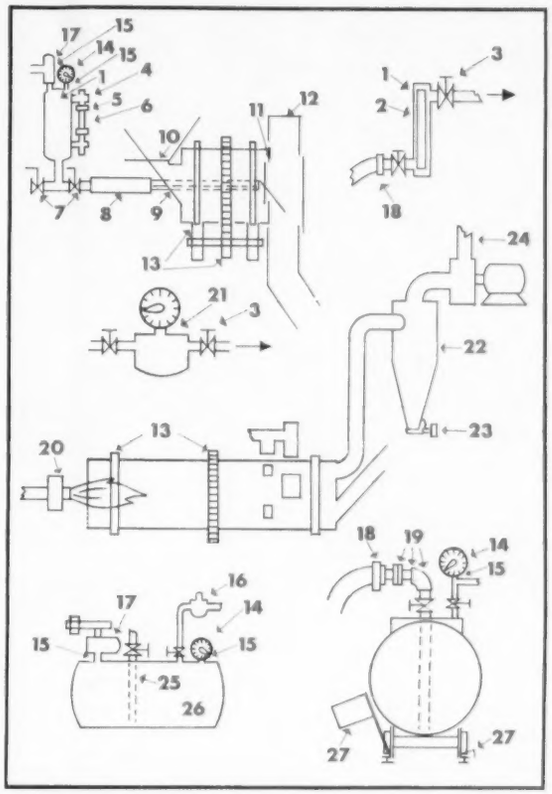
"ARCADIAN", "NITRANA", "URANA" and "U-A-S" are trade-marks of Allied Chemical Corporation.

Arcadian News for Fertilizer Manufacturers . . . . . from NITROGEN DIVISION

It Pays to Check Your Equipment

Here are some of the points to check to insure safe and efficient operation:

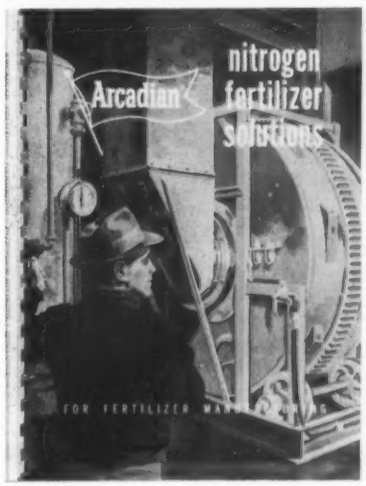
Action Needed	OK	
☐	☐	1 Measuring tanks, rotometers—use correct specific gravities.
☐	☐	2 Rotometer. Check float for wear and corrosion. Shield against breakage. Avoid mechanical strains.
☐	☐	3 Throttle on discharge side – to minimize vaporization of nitrogen solutions.
☐	☐	4 Gauge glass connections—fittings—free for easy cleaning.
☐	☐	5 Extra gaskets for gauge glasses.
☐	☐	6 Clean glass tubes. Make sure you have spare tubes.
☐	☐	7 Valves. Check for wear. Have spare parts on hand.
☐	☐	8 Rubber hose to reduce vibrations.
☐	☐	9 All distributor pipes for design and condition.
☐	☐	10 Mixer inlet gate for leakage.
☐	☐	11 Mixer discharge door for leakage.
☐	☐	12 Rotary batch mixer. Avoid suction in mixer.
☐	☐	13 Tires, trunions, ring gears and pinion for alignment, wear and safeguards.
☐	☐	14 Pressure gauges – for ammonia service? – accurate? Do not let pressure continue to rise. These are not clocks.
☐	☐	15 Location of gauges and safety valves on storage tanks. If connected into or near high velocity air line, they are not accurate during movement of air.
☐	☐	16 Pressure regulators. They are not safety devices.
☐	☐	17 Pressure and vacuum reliefs. Check operations. Remove weights unofficially added.
☐	☐	18 Hose connections. Adequate stainless steel bolted clamps.
☐	☐	19 Tank car connections. Stainless steel and short for strength and permanence. Use elbows to avoid hose kinks.
☐	☐	20 Dryer burner – clean, adjust, and check controls.
☐	☐	21 Displacement meters. Lose accuracy at low rate of flow and with gas bubbles.
☐	☐	22 Dust collector. Check for condensation, caking, deterioration, overloading. Clean fan blades.
☐	☐	23 Check for air leaks at dust collector discharge.
☐	☐	24 Stacks. Check for fouling and corrosion.
☐	☐	25 Storage tank dip pipes. Check for leaks.
☐	☐	26 Tanks. Check for weakening by corrosion, and failure of any coating or lining.
☐	☐	27 Tank cars. Always blue flag and block wheels.



OTHER PRECAUTIONS: Make sure operators have proper training and instruction. Equip them with rubber gloves and goggles. Have good lighting and safe exits. Keep safety literature handy. Have gas masks and a supply of water for emergencies. Emergency shower baths should be freeze-proof and warm for cold weather.

SEND FOR YOUR COPY

The ARCADIAN® manual on Nitrogen Fertilizer Solutions is packed with useful information. If you do not have a copy, obtain yours from: Nitrogen Division, Allied Chemical, 40 Rector Street, New York 6, N. Y.



HERE'S THE BIG LINE OF Arcadian® NITROGEN SOLUTIONS

When you purchase your nitrogen requirements from Nitrogen Division Allied Chemical, you have many different nitrogen solutions from which to select those best suited to your ammoniation methods and equipment. You are served by America's leading producer of the most complete line of nitrogen products on the market. You get formulation assistance and technical help on manufacturing problems from the Nitrogen Division technical service staff. You benefit from millions of tons of nitrogen experience and the enterprising research that originated and developed nitrogen solutions.

	CHEMICAL COMPOSITION %						PHYSICAL PROPERTIES		
	Total Nitrogen	Anhydrous Ammonia	Ammonium Nitrate	Urea	Water	Neutralizing Ammonia Per Unit of Total N (lbs.)	Approx. Sp. Grav. at 60°F	Approx. Vap. Press. at 104°F per Sq. In. Gauge	Approx. Temp. at Which Salt Begins to Crystallize °F
NITRANA®									
2	41.0	22.2	65.0	—	12.8	10.8	1.137	10	21
2M	44.0	23.8	69.8	—	6.4	10.8	1.147	18	15
3	41.0	26.3	55.5	—	18.2	12.8	1.079	17	-25
3M	44.0	28.0	60.0	—	12.0	12.7	1.083	25	-36
3MC	47.0	29.7	64.5	—	5.8	12.6	1.089	34	-30
4	37.0	16.6	66.8	—	16.6	8.9	1.184	1	56
4M	41.0	19.0	72.5	—	8.5	9.2	1.194	7	61
6	49.0	34.0	60.0	—	6.0	13.9	1.050	48	-52
7	45.0	25.3	69.2	—	5.5	11.2	1.134	22	1
URANA®									
6C	43.0	20.0	68.0	6.0	6.0	9.3	1.180	12	39
6M	44.0	22.0	66.0	6.0	6.0	10.0	1.158	17	14
10	44.4	24.5	56.0	10.0	9.5	11.0	1.114	22	-15
11	41.0	19.0	58.0	11.0	12.0	9.2	1.162	10	7
12	44.4	26.0	50.0	12.0	12.0	11.7	1.087	25	- 7
13	49.0	33.0	45.1	13.0	8.9	13.5	1.033	51	-17
15	44.0	28.0	40.0	15.0	17.0	12.7	1.052	29	1
U-A-S®									
A	45.4	36.8	—	32.5	30.7	16.2	0.932	57	16
B	45.3	30.6	—	43.1	26.3	13.5	0.978	48	46
Anhydrous Ammonia	82.2	99.9	—	—	—	24.3	0.618	211	-108

Other ARCADIAN® Products: URAN® and FERAN® Solutions • Ammonia Liquor • N-dure® A-N-L® • Ammonium Nitrate • UREA 45 • Nitrate of Soda • Sulphate of Ammonia

NITROGEN DIVISION

Allied Chemical

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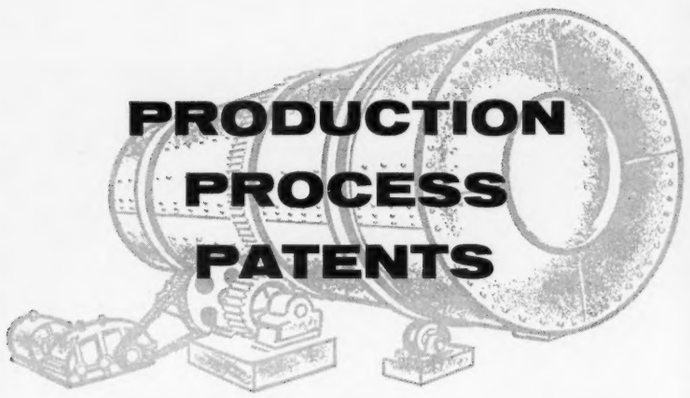
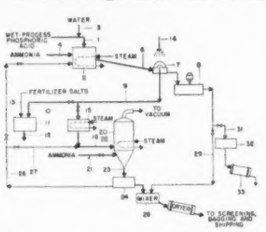


2,891,856

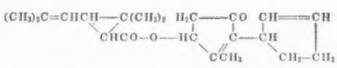
Manufacture of Fertilizer from Wet-Process Phosphoric Acid and Ammonia. Patent issued June 23, 1959, to John G. Getsinger, Florence, Ala., and Robert L. Haunschild, Kansas City, Mo.; said Getsinger assignor to Tennessee Valley Authority. In a process for the production of fertilizer from wet-process phosphoric acid and ammonia, that improvement which comprises adjusting the concentration of wet-process phosphoric acid to the range from about 20 to



28% P_2O_5; introducing ammonia into the acid at a rate below 15 pounds of ammonia per hour per cubic foot of acid solution; raising the temperature of the acid solution to its boiling point before rapid precipitation occurs; discontinuing introduction of ammonia when the pH of the resulting suspension is in the range from about 4.5 to 5.5, and separating the resulting easily separable precipitate from the solution without strong agitation.

2,891,888

3-(2-Cyclopentenyl)-2-Methyl-4-Oxo-2-Cyclopentenyl Chrysanthemumate Insecticide and Process of Making it. Patent issued June 23, 1959, to Howard R. Guest and Harry A. Stansbury, Jr., South Charleston, W.Va., assignors to Union Carbide Corp., New York. As a new composition of matter, 3-(2-cyclopentenyl)-2-methyl-4-oxo-2-cyclopentenyl chrysanthemum-monocarboxylate, represented by the graphic formula



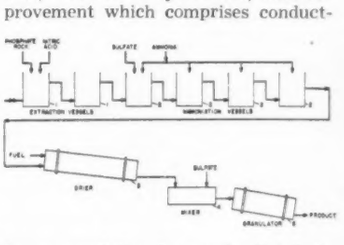
The method of controlling insects which comprises applying 3-(2-cyclopentenyl)-2-methyl-4-oxo-2-cyclopentenyl chrysanthemumate to a base.

2,879,152

Manufacture of Fertilizers. Patent issued March 24, 1959, to Gordon A. Coleman, Philadelphia, Pa., assignor to Allied Chemical Corp. A continuous process for preparing a nitrogen-phosphate base fertilizer which comprises reacting phosphate rock with an aqueous solution of H_2SO_4 and HNO_3 for a period of time sufficient to convert substantially the entire phosphate content of said rock to H_3PO_4, there being at least about 2 equivalents of H_2SO_4 present in said solution per 3 equivalents of HNO_3, the total amount of acid present being 33-200% in excess of that theoretically required to effect said conversion to H_3PO_4 and the water content of the reaction mixture being 8 to 120 parts per 100 parts of phosphate rock giving a mixture with an apparent acid strength of at least about 50%, adding water to the acidulated reaction mixture in an amount sufficient to decrease the apparent acid strength of said mixture to within the range of 15% to 25%, subjecting the resulting aqueous mixture comprising $CaSO_4$, H_3PO_4 and excess acid, without any previcus curing step, to reaction with gaseous ammonia at a maximum temperature not exceeding 85° C. and at a maximum pH not exceeding 7 for a period of time sufficient to transform substantially all of said H_3PO_4 to dicalcium phosphate and ammonium phosphates, said aqueous mixture being in the form of a thin slurry during and after ammoniation, removing most of the undissolved solids as product from the ammoniated slurry and recycling the remaining aqueous liquor containing 10 to 50% solids in solution by addition to a succeeding acidulated reaction mixture to be ammoniated, the water in said aqueous liquor constituting a major portion of the water added to said succeeding reaction mixture prior to ammoniation thereof.

2,879,153

Production of Fertilizer. Patent issued March 24, 1959, to Francis T. Nielsson, Sheffield, Ala., assignor to Tennessee Valley Authority. A process for the production of fertilizer wherein phosphate rock is mixed with at least enough nitric acid to convert the calcium phosphate content of said rock to monocalcium phosphate, ammonia is added to the resulting slurry, calcium nitrate is present in the slurry after ammoniation, a soluble sulfate in quantity sufficient to convert all calcium nitrate present to calcium sulfate is added to the slurry after ammoniation, and the slurry is dried, that improvement which comprises conducting ammoniation by evenly distributing in the slurry an amount of ammonia from about 1.0 to 1.2 times that theoretically required to precipitate all phosphate present in the form of dicalcium phosphate and all fluorine present as calcium fluoride in the presence of sufficient potassium sulfate to give a K_2O/P_2O_5 mole ratio of about 0.2:1 to 0.55:1 in the slurry; precipitating some calcium as citrate-soluble phosphatic compounds having a CaO/P_2O_5 mole ratio greater than that of dicalcium phosphate; drying the resulting slurry to a moisture content of about 4 to 8 percent at a temperature high enough to maintain the slurry in fluid state; mixing sufficient potassium sulfate with the resulting hot, fluid slurry to react with all calcium nitrate present; and cooling and granulating the resulting mixture.



2,887,362

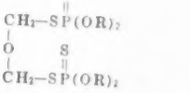
Manufacture of Phosphoric Acid. Patent issued May 19, 1959, to Roy Lee, Jr., Houston, Texas, assignor to Phillips Petroleum Co. In a method for production of phosphoric acid according to the wet process, comprising the steps of reacting in a reaction zone solid phosphatic material with sulfuraic acid and dilute recycle phosphoric acid, maintaining with agitation the resulting reaction mixture in said reaction zone, passing all of said reaction mixture to a separation zone and there separating by filtration a liquid component comprising phosphoric acid containing a relatively dilute fines suspension of a small amount of calcium sulfate, and a coarse-solids slurry of a major amount of calcium sulfate, and recycling a portion of said phosphoric acid to said reaction zone, the improvement comprising passing said liquid component containing said suspension of calcium sulfate fines to a clarification zone and imparting to said liquid component a rotary flow along a spiral path thereby separating said fines suspension of calcium sulfate from said phosphoric acid prior to concentrating the latter, and recycling said fines suspension of calcium sulfate to said reaction zone.

2,884,318

Nitrogen-Phosphorus Compositions. Patent issued April 28, 1959, to Curtis G. Christian, Anaheim, Cal., assignor to Collier Carbon & Chemical Corp., Los Angeles. The process which comprises contacting elemental phosphorus with a gas mixture comprising between about 0.1 and about 5 volume percent of oxygen and at least about 5 volume percent of anhydrous ammonia at a reaction temperature below about 150° C., said amount of oxygen being less than that sufficient to oxidize said elemental phosphorus to phosphorus pentoxide, whereby there is formed a substantially non-hygroscopic solid product containing about 19% by weight of nitrogen and about 30% by weight of phosphorus.

2,884,353

Dithiophosphate Insecticides. Patent issued April 28, 1959, to Donald L. Christman, Wilmington, Del., assignor to Hercules Powder Co., Wilmington. As a new composition of matter, a compound of the formula

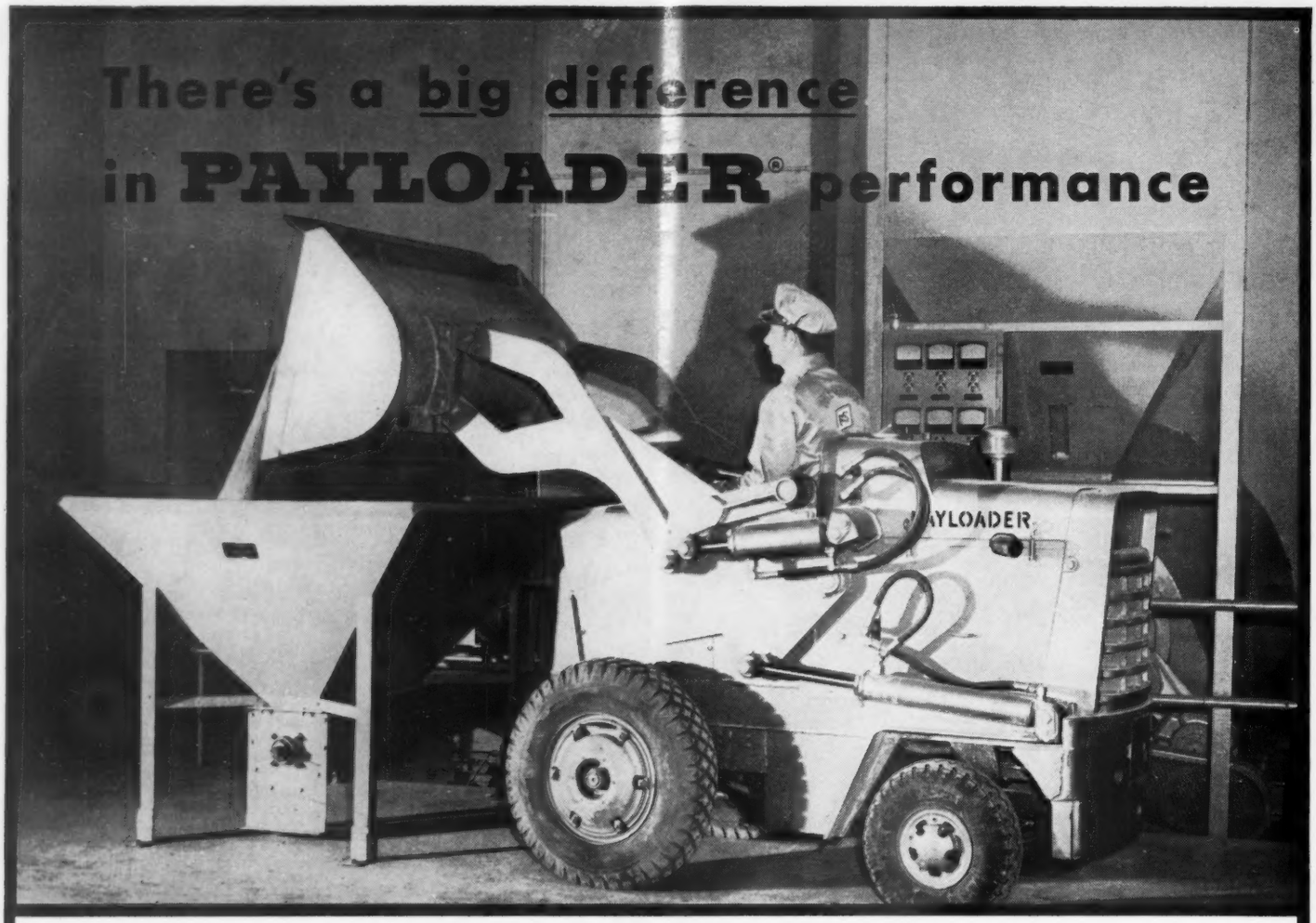


Sulfuric Acid—Annual Shipments and Production, 1955-1958

Product code	Product	Year	Total shipments including interplant transfers: Quantity (short tons of 100% H_2SO_4)	Total shipments including interplant transfers: Value f.o.b. plant ($1,000)	Commercial shipments only: Quantity (short tons of 100% H_2SO_4)	Commercial shipments only: Value f.o.b. plant ($1,000)	Production (quantity): Total (short tons of 100% H_2SO_4)	Production (quantity): Consumed in producing plant (short tons of 100% H_2SO_4)
2811---	Sulfuric acid, gross (new and fortified), total	1958	9,366,917	170,969	8,926,814	155,011	[1]15,950,199	6,639,740
		1957	*9,689,989	*177,403	*8,907,586	*162,091	[1]16,459,608	*6,744,136
		1956	9,766,185	188,420	9,042,738	167,604	[1]16,494,558	6,762,980
		1955	9,826,145	188,832	9,098,254	174,502	[1]16,254,991	6,497,857
2811071	Chamber process (gross)	1958	695,361	12,202	(D)	(D)	1,741,756	1,077,110
		1957	861,917	*14,981	(D)	(D)	1,988,305	1,119,691
		1956	992,841	17,410	821,770	15,689	2,235,600	1,305,954
		1955	976,268	17,878	765,273	13,497	2,320,972	1,372,230
	Contact process (gross)	1958	8,671,556	158,767	(D)	(D)	[2]14,206,443	5,362,630
		1957	*8,828,072	*160,422	(D)	(D)	[2]14,471,305	*5,624,443
		1956	8,773,344	165,010	8,220,968	153,915	[2]14,260,958	5,956,626
		1955	8,847,877	170,954	8,332,981	161,005	[2]15,954,019	5,125,607
2811011	Oleum under 40%	1958	1,052,619	21,049	(D)	(D)	1,458,043	394,104
		1957	*1,028,507	*20,714	(D)	(D)	*1,502,959	467,765
		1956	987,555	20,203	912,466	18,554	1,458,584	470,506
		1955	999,184	20,073	(D)	(D)	1,350,612	405,848
2811015	Oleum 40%	1958	(D)	(D)	(D)	(D)	42,907	(D)
		1957	*22,218	*425	*22,218	*425	116,260	*100,308
		1956	65,855	1,280	65,855	1,280	275,970	212,565
		1955	84,250	1,650	(D)	(D)	359,416	(D)
2811017	Oleum above 40%	1958	(D)	(D)	(D)	(D)	65,787	(D)
		1957	*49,378	*1,368	(D)	(D)	*65,244	(D)
		1956	53,541	1,490	(D)	(D)	70,288	(D)
		1955	52,173	1,468	(D)	(D)	70,259	(D)
2811031	Other than oleum	1958	7,557,843	135,975	6,898,125	123,862	12,641,704	5,121,089
		1957	*7,727,969	*139,915	*7,165,370	*129,892	*12,788,842	5,042,771
		1956	7,668,393	142,057	7,204,648	132,950	12,456,096	4,756,708
		1955	7,732,288	147,763	7,322,321	139,694	12,155,732	4,424,595
2811X51	Spent acid used for fortification in contact units and included in above figures	1958	xxx	xxx	xxx	xxx	xxx	669,776
		1957	xxx	xxx	xxx	xxx	xxx	691,389
		1956	xxx	xxx	xxx	xxx	xxx	737,190
		1955	xxx	xxx	xxx	xxx	xxx	955,631

*Revised.
xxx Not applicable.
D Withheld to avoid disclosing figures for individual companies.
[1]Total new (virgin) acid production in short tons of 100% H_2SO_4 is as follows: 15,280,423 for 1958; 15,768,225 for 1957; 15,737,348 for 1956; and 15,519,360 for 1955.
[2]Total new (virgin) contact acid contact production in short tons of 100% H_2SO_4 is as follows: 13,558,667 for 1958; 13,779,982 for 1957; 13,503,748 for 1956; and 12,998,588 for 1955.

SULFURIC ACID PRODUCTION AND SHIPMENTS—This table, prepared by the U.S. Department of Commerce, gives the sulfuric acid picture as noted over the past four years, 1955-58 inclusive. Both volume and dollar value have dropped slightly during that period, the report indicates. The drop from 1957's total to that of 1958 was approximately 3%. Total tonnages were 16,459,608 and 15,950,199 tons, respectively. The Department of Commerce reported that about 89% of the 1958 output was produced by the contact process as compared to 88% of the 1957 total.



Big Load Capacity The model H-25 "PAYLOADER" tractor-shovel has a carry capacity of 2,500 lbs. — carries more for its weight than any machine in its class.

More Digging Power Breakout force of 4,500 lbs. is available at the bucket cutting edge — more than on any machine near its size. Exclusive power-transfer differential makes traction and "crowding" power more positive, especially when traction conditions are slippery.

More Maneuverable Shortest turning radius (only 6 ft. at rear wheel hub) and power-steer make it possible to operate in closer quarters with greater speed and safety.

Power-shift Transmission The model H-25 is the only machine in its class having a full-reversing power-shift transmission with two speed ranges forward *and* reverse — the low ranges for digging power and close maneuvering, the high ranges for fast, economical travel. All "clutching" and gear-shifting is eliminated.

Lower Maintenance The boom and bucket mechanism is of rugged, simple design with fewer parts and linkages. Quality materials are used throughout, including anti-friction bearings at critical pivot points.

Longer Life The most complete system of protection has been engineered into the Model H-25 to insure long life and freedom from trouble: triple air cleaning system for the engine; cartridge-type filters for all three oil systems; self-adjusting, sealed hydraulic brakes; closed, pressure-controlled hydraulic system; grease and oil seals on all pivots and ball joints.

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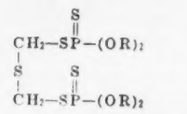
in which each R represents a lower alkyl radical. A pesticidal composition comprising the compound of the previous claim and an insecticidal adjuvant.

2,884,354

Dithiophosphate Insecticides. Patent issued April 28, 1959, to Donald L. Christman, Wilmington, Del., assignor to Hercules Powder Co., Wilmington. As a new composition of



matter a compound of the formula wherein each R represents a lower alkyl radical. A pesticidal composition comprising a compound of the earlier claim and an insecticidal adjuvant.

2,884,355

Insect Repellent Composition Comprising a Diethyl, Di-N-Propyl or Di-N-Butyl Pyridine Dicarboxylate, a Stabilizer and a Method of Use. Patent issued April 28, 1959, to Lyle D. Goodhue, Bartlesville, and Kenneth E. Cantrel, Dewey, Okla., assignors to Phillips Petroleum Co. An improved fly repellent composition comprising about 1 part by weight of a dicarboxylate selected from the group consisting of diethyl-, di-n-propyl-, and di-n-butyl pyridine dicarboxylates and about 1 to 10 parts by weight of a stabilizing compound selected from the group consisting of N-ethylhexyl bicylo [2.2.1] -5-heptane-2,3-dicarboxyimide and 1[2,5,8-trioxadodecyl]-2-propyl-4,5-methylenedioxybenzene.

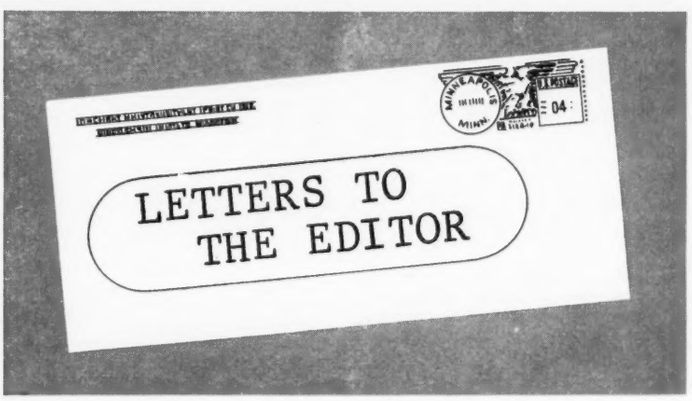
An improved fly repellent composition comprising about one part by weight of diethyl pyridine dicarboxylate and about two parts by weight of n-octyl 3-(3,4-methylenedioxybenzene) propyl sulfoxide.

2,885,263

Anhydrite Process for Phosphoric Acid Manufacture. Patent issued May 5, 1959, to Robert B. Peet, Danbury, Conn., assignor to Chemical Construction Corp., New York. A method for the production of strong phosphoric acid of at least 40% P_2O_5 content which comprises digesting phosphate rock in strong aqueous phosphoric acid, reacting the resulting monocalcium phosphate solution with sulfuric acid, thereby forming a suspension of calcium sulfate hemihydrate crystals in aqueous phosphoric acid of at least 40% P_2O_5 content, said sulfuric acid being added in amounts which are about 1-4% in excess of that necessary to react with monocalcium phosphate in said suspension, adding seed crystals of calcium sulfate anhydrite to said suspension, heating this suspension at temperatures of at least 100° C. for about 1-4 hours to convert a major proportion of said calcium sulfate hemihydrate crystals into crystals of calcium sulfate anhydrite, and filtering the slurry so obtained to produce a filter cake of calcium sulfate anhydrite crystals and a filtrate of strong phosphoric acid of at least 40% P_2O_5 concentration.

2,885,264

Hemihydrate Process for Phosphoric Acid Manufacture. Patent issued May 5, 1959, to Robert B. Peet, Danbury, Conn., assignor to Chemical Construction Corp., New York. A method for the production of strong phosphoric acid of at least 40% P_2O_5 concentration which comprises reacting phosphate rock with strong aqueous phosphoric acid of at least 40% P_2O_5 content in a digesting step at temperatures of at least 80° C. and introducing the resulting monocalcium phosphate solution into a first precipitating and crystallizing step along with sulfuric acid and additional phosphoric acid, said sulfuric acid being added in said precipitating and crystallizing step in amounts from 1.5% to 3% less than the stoichiometric equivalent of the monocalcium phosphate precipitating about 85% to 90% of the calcium sulfate as hemihydrate, maintaining therein a temperature of at least 80° C. and a phosphoric acid concentration of at least 40% P_2O_5 thereby forming a suspension of smooth and easily filterable calcium sulfate hemihydrate crystal agglomerates in phosphoric acid which also contains the remaining monocalcium phosphate, recovering a portion of said phosphoric acid containing calcium sulfate hemihydrate crystal agglomerates in suspension and recycling said portion to said initial digestion step, passing the remaining portion of the phosphoric acid with suspended calcium sulfate hemihydrate crystal agglomerates to a second precipitation and crystallization step and reacting said remaining portion of the monocalcium phosphate with additional sulfuric acid sufficient to precipitate the remaining soluble calcium as calcium sulfate, and separating the thus produced strong phosphoric acid of at least 40% P_2O_5 content from the precipitated calcium sulfate by filtration.



To the Editor:

We note your recent issue of June 8th and the article, "Contentions of Many Years Still Rage Over Organics vs. Chemicals" by Dr. Vincent Sauchelli, Chemical Technologist, National Plant Food Institute. The article appears to have much merit in that it recognizes that the age old controversy has not been settled and that there is evidence to support both sides of the story.

Of course, when the term "organics" is used, immediately the idea comes to mind that the material in question is all organic in structure or in other words combustible. Nothing could be further from the true scheme of things. Recent experimental work by the University of Minnesota has established the value of mineral materials not quickly soluble and, of course, right there the point is raised, "just how available do minerals need to be to perform their best service to the soil?"

Of course, to advocates of soluble plant food the question might be asked, "how come a worthless soil literally incapable of supporting plant life as a result of exhaustive cropping practices can be made to produce profusely with only the addition of a top layer of heavy mulch of moldy hay or anything else similar?" Certainly no plant foods of any kind were added to the soil but yet it seems to have rejuvenated itself even though the organic mulch was not decayed and incorporated in the soil so it must be considered that the soil is capable of carrying on its own renovation practices if given the proper inducement.

We look forward to reading more of Dr. Sauchelli's articles.

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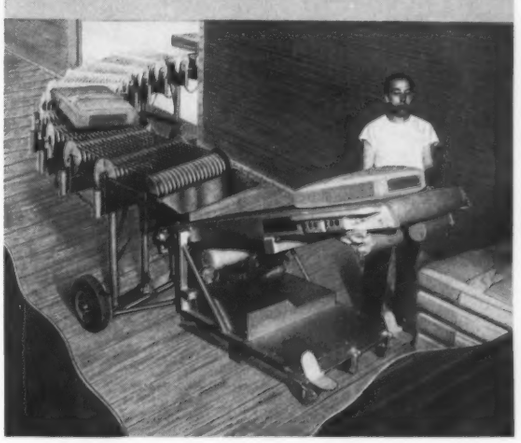
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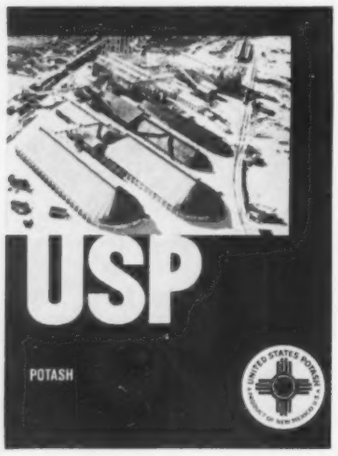
What's New?

Additional information is available about new products, new services, and literature described in this department. Circle the numbers of items on which you desire more information, fill in your name, your job title, your company's name and address on the card. Then clip it out of the page and mail. No postage is necessary.

No. 9088—Potash Brochure

U.S. Potash Co., Division, United States Borax & Chemical Corp., has just published a product brochure which describes the properties and uses of the firm's muriate of potash products. The four page booklet, printed in two colors, describes the three grades of potash, standard, coarse and granular, presenting typical chemical analyses, particle size analysis and uses of the various materials in fertilizer manufacturing.



A brief story of the company's mining operations in New Mexico, plus shipping information on the products are also included in the brochure. To get a copy of the booklet, check No. 9088 on the coupon and mail it. No postage necessary.

No. 9089—Nitrogen Manual

Texaco, Inc. offers a new manual on ammonia and nitrogen solutions. The helpful manual contains information on the manufacture of ammonia and nitrogen solutions; specifications of the firm's products; mixed fertilizer manufacturing processes; comparison of pug-mill and granulating drum process, choosing fertilizer ingredients and solutions; data on rates of ammoniation and recycle; moisture control, temperature control, cooling, screening, sample formulation calculations, liquid mixed fertilizers, and various tables and charts. Other subjects covered in the comprehensive booklet include hygroscopicity and solubility of common fertilizer materials, amounts of nitrogen in various nitrogen fertilizers, specific gravity, vapor pressures and properties of various materials, and data on sulfuric acid and phosphoric acid. A two-way temperature conversion scale is also included in the material. The booklet is available if you check No. 9089 on the coupon, and mail it.

No. 9090—Bag Feeder

A new fully operational automatic open-mouth multiwall bag feeder has been announced by Bemis Bro. Bag Co. The new equipment will operate at speeds of 16 bags a minute, the maker says, and at even higher speeds with some free-flowing products. Known by the trademark "Auto-Mac," the multiwall bag feeder handles a wide range of bag dimensions, 50 lb. and up.

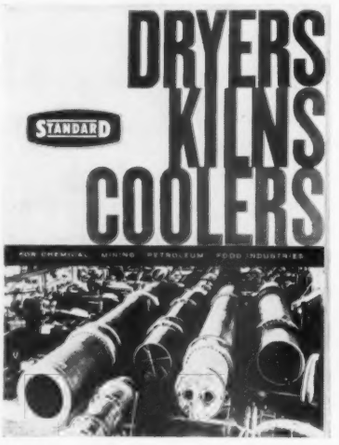
Features of the new device include a control system for simplicity of operation. A switch activates the cycling operation and individual controls regulate the speed. Bag width

and length are adjusted by convenient handwheels, the company says.

The device automatically feeds the bag to the bagholder which receives the discharge of product from an overhead scale and as the product is discharged into the bag, the machine automatically delivers the filled bag ready for closing. The bags are handled by steel arms containing suction cups. Full information is available by checking No. 9090 on the coupon and mailing it.

No. 9093—Dryer Bulletin

Its line of dryers, kilns, coolers and other heavy rotary processing equipment for the chemical and allied industries are described in a new 28-page technical bulletin published by Standard Steel Corp. Included are installation photographs, interior views of rotary dryers, a discussion on "How to Make Decisions on Rotary Processing Equipment," a thorough description of the types of dryers and special equipment manufactured by the company, and four engineering graphs for use in making calculations for new drying and cooling installations. Copies of the new bulletin are available by checking No. 9093 on the coupon and mailing it.



No. 9094—Pesticide Formulation Bulletin

Emulsol Chemical Corp., Division of Witco Chemical Co., has published a comprehensive new "Guide to Quality Pesticide Formulations" loose-leaf bulletin, fully illustrated and documented. Its purpose, according to the foreword, is "to guide the formulator towards high quality emulsifiable pesticide concentrates. . . . The typical systems described can easily be modified to suit individual requirements. The general discussion of basic problems and the suggestions offered are presented as a basis for the development of new formulations and the improvement of those already in use."

The new booklet is divided into sections under the headings of physical properties, formulating aids, matched pairs, formulations, specialized formulations, and liquid fertilizer-pesticides. Instructions and recommendations for the formulation of various types of pesticides for different purposes and applications are given throughout the book. An appendix lists petroleum hydrocarbon solvent suppliers throughout the U.S. The booklet is available by checking No. 9094 on the coupon and mailing it.

No. 9058—Bag Tear Strip

Union Bag-Camp Paper Corp. announces the development of a tape tear strip which opens the top of Diamond "O" type multiwall bags quickly and creates a pouring spout. Called Unistrip, it consists of a flat

5/32 in. wide tape held in place in the valve of the bag by a quick-drying adhesive, the company says. The length of the strip has been standardized at 6 in. It can, the company says, be furnished in strips up to 10 in. at additional cost. For details check No. 9058 on the coupon and mail to this publication.

No. 9047—Centrifugal Blower

A new 4-page bulletin on its complete line of centrifugal blowers has been announced by the Young Machinery Co., Inc. The bulletin and check list described blowers made of carbon steel, stainless, or other alloys. They are high-pressure, low volume units used as industrial exhausters. The blowers are said to be made of rugged fabricated construction with heavy wear-resistant rotors capable of handling light concentrations of dust. For copy of the bulletin, check No. 9047 on the coupon.

No. 9096—Bulk Transport

Dorsey Trailers announces the Bulkmaster self-unloading bulk transport for handling a variety of dry materials. Designated model FB-T, the unit unloads fertilizer,

Send me information on the items marked:

- ☐ No. 9047—Centrifugal Blower
- ☐ No. 9053—New Products Catalog
- ☐ No. 9058—Bag Tear Strip
- ☐ No. 9088—Potash Brochure
- ☐ No. 9089—Nitrogen Manual
- ☐ No. 9090—Bag Feeder
- ☐ No. 9091—Pipe Coupling
- ☐ No. 9092—Gas Heater
- ☐ No. 9093—Dryer Bulletin
- ☐ No. 9094—Pesticide Formulation Bulletin
- ☐ No. 9095—Air Vibrator
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lime, salt, seed, coke, sulfur and other dry granular commodities, the company says. The unit pit dumps or can be equipped with a 14 ft. folding or rigid full-swiveling 18 in. wide endless-belt elevator. A boom and cable assembly swivels the elevator around to lie flat against the body when not in use. A tandem hydraulic pump, powered by a 25 h.p. air-cooled gas engine, supplies pressure to operate the rubber belt conveyor, which is riveted to a 36 in. heavy-duty steel conveyor chain and elevators, the company says. The system discharges in excess of one ton per minute, depending on the material. For details check No. 9096 and mail.

No. 9095—Air Vibrator

A new line of "Flask-Rapper" air vibrators has been announced by National Air Vibrator Co. The vibrator can be used to shake-out and pack in containers such bulk materials as

feed, chemicals and other flowing products. Units are designed for low air consumption, company literature said, and operate on 35 to 65 psi. Two models are available: the FR-3 weighs 74 lb. and has a 3 in. piston, and the FR-4 weighs 115 lb. and has a 4 in. piston. For details, check No. 9095 on the coupon and mail to this publication.

No. 9091—Pipe Coupling

OPW Jordan has new literature available describing its line of "kamlok" quick couplings with new "Viton-A" gaskets. These couplings are used wherever hose or pipe connec-

tions are disconnected periodically to save time and operating costs. The gaskets are suitable for hard-to-handle chemicals and steam services, the makers state. These couplings and gaskets are suitable for pressures to 200 PSI and temperatures to 500° F., the company says. Complete specifications, illustrations, chemical recommendation charts, prices and features are all given in bulletins published by the company. Check No. 9091 on the coupon and mail it promptly.

No. 9099—Coding System

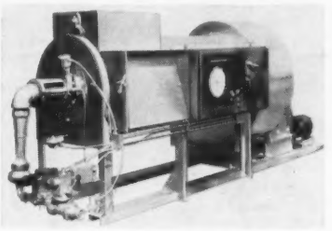
Ultra-Violet Products, Inc., announces a coding system for marking cartons and crates of all sizes. The system utilizes invisible ink for marking corrugated cardboard, heavy paper and other porous surfaces. The ink can be applied with felt point pens, a stamping machine, from a stamp pad or with a brush. Normally invisible and transparent in white light, the ink shines bright blue under long wave ultra-violet or black light. It is both non-flammable and non-toxic, the company said. For details, check No. 9099 on the coupon and mail.

No. 9097—Coating For Containers

Monsanto Chemical Co.'s inorganic chemicals division has announced the publication of a comprehensive technical bulletin on the use of its Syton P (colloidal silica solution) as an anti-slip and anti-soil coating on bag and paperboard carton surfaces. In addition to a description of the physical and chemical properties of the product, the bulletin gives details as to application by both spray and roll methods, recommended solutions, methods of measuring applications and general handling information. Copies are available. Check No. 9097 on the coupon to obtain them.

No. 9092—Gas Heater

Gas Appliance Service, Inc. offers information on its gas drying units used in many heat processing applications. The firm has a package unit,



complete with control cabinet and instruments, completely wired, in capacities from 125,000 BTU's/hr. to 4,000,000 BTU's/hr. The units are also furnished without wiring for installations requiring remote control. Temperatures of standard models range up to 600° F. Other models have temperatures up to 1000°. The newer type of air heaters employs injector-type atmospheric burners, combination gas-oil burners can be provided if desired. Further information is available by checking No. 9092 on the coupon and mailing it.

No. 9053—New Products Catalog

Publication of the latest edition of its products catalog describing properties and uses of 375 industrial, pharmaceutical and agricultural chemicals, is announced by the Dow Chemical Co. The 1958-59 issue is the fourth annual booklet issued by Dow. Containing a new cover and new features, the catalog is a ready reference for Dow's broad range of chemicals. This catalog may be obtained without cost by checking No. 9053 on the coupon and mailing it.

Count on a Sohio contract to

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FIGURING your nitrogen requirements is often the difficult part of planning next year's program. But a Sohio contract ends much of the work and worry.

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SURFACTANTS

Continued from page 2

under one of three conditions. They are (a) adverse growing conditions or adverse weather conditions following application, (b) the dosage applied is low, or (c) where the plant itself is difficult to wet. I think in many cases where surfactants have not given decided help in killing plants, you will find one or more of those conditions violated.

In formulations already containing a lot of surfactant, as in the case of 2,4-D esters, the addition of further surfactant is of little value. There is a limit in what these surfactants do in lowering the surface tension of water and increasing wettability.

One of the things a surfactant does when added to water is to lower the tension of the water and increase its wettability, but there is a minimum point at a certain concentration of the surfactant. If you continue to add surfactant there is no continuing lowering of the surface tension. Actually, when excessive amounts of surfactant are in solution, the surface tension tends to go up a little. This clearly proves that there is an optimum amount of surfactant to be added and there is no point in adding any further amount.

At this point, we are ready to ask about ways the increased absorption brought about by the surfactant is helpful.

First of all, surfactants increase the effectiveness of the herbicides as a result of the increased absorption. This was shown in Table 4 on sodium chlorate.

Secondly, it helps by increasing the wetting by the spray solution of hard-to-wet plants. This means that more chemical will remain on the plant and there will be a bigger area of the plant wetted and consequently a larger area of contact between the spray and the plant resulting in absorption of more chemical.

Third, when plants are growing under adverse conditions they develop rather thick cuticles and may not have their stoma open to absorb. The surfactant not only wets this cuticle but actually reacts with it to soften and open it up to the penetration of the herbicide.

Fourth, we find the conditions of the field or certain reactions of the chemical may operate against us in absorption and killing the plant. For example, the chemical may be broken down by the ultra violet rays of the sun and speedy absorption is necessary. Again, the chemical may be volatile and if not absorbed within a few hours the chemical is lost from the plant surface. Another factor may be that the chemical is applied under very low humidity conditions and the water used as a carrier may evaporate leaving a deposit of the dry crystalline chemical.

Finally, we have the case of rain following in a few hours after an application and washing the chemical off. Now, these are all conditions where the increased rate of absorption brought on by the presence of a surfactant coupled with the greater total amount absorbed in any given time definitely establish the value of the use of a surfactant with herbicides. A wetting agent or surfactant acts as an insurance policy to guarantee maximum effectiveness under these conditions.

What about the surfactants themselves? There are a large number of surfactants, and the question arises whether so many are justified. In other words, are all wetting agents about equally effective?

The answer is a resounding NO. Although there have been very few studies made comparing different surfactants in herbicide applications, it is already apparent that there are tremendous differences between surfactants in their promotion of absorption, and no single surfactant is going to be the right one for all problems.

To illustrate the difference in surfactants, we present Table 5, wherein there is presented a comparison of the surface tension of 1/10th of 1% of a solution of four different surfactants, and then the time in seconds required for the solution to wet a skein of yarn. (The time required for a skein of yarn to sink the solution is known as the Draves test. It is used extensively by the textile industries to measure the value of surfactants.)

TABLE 5. Variation of Wettability

Wetting Agent No.	S.T.	Time Required to Wet Sec.
1	33.5	20
2	39	30
3	47	15
4	62	35

Are the differences in surfactants on the basis of laboratory tests the same as on a plant? Table 6 shows ATA was mixed with three different surfactants at .05 of 1%. The surface tension of these solutions was measured and the amount of chemical absorbed in 24 hours determined.

TABLE 6. Effect of Various Surfactants on ATA Absorption

Solution	Dose/ Plant	S.T.	pH	% Absorbed in 24 hr.
ATA	250	69.6	5.87	13.1
ATA + .05% Multi. C	250	50.3	5.90	18.8
ATA + .05% Multi. L	250	59.1	6.40	25.5
ATA + .05% X-77	250	33.3	5.82	77.8

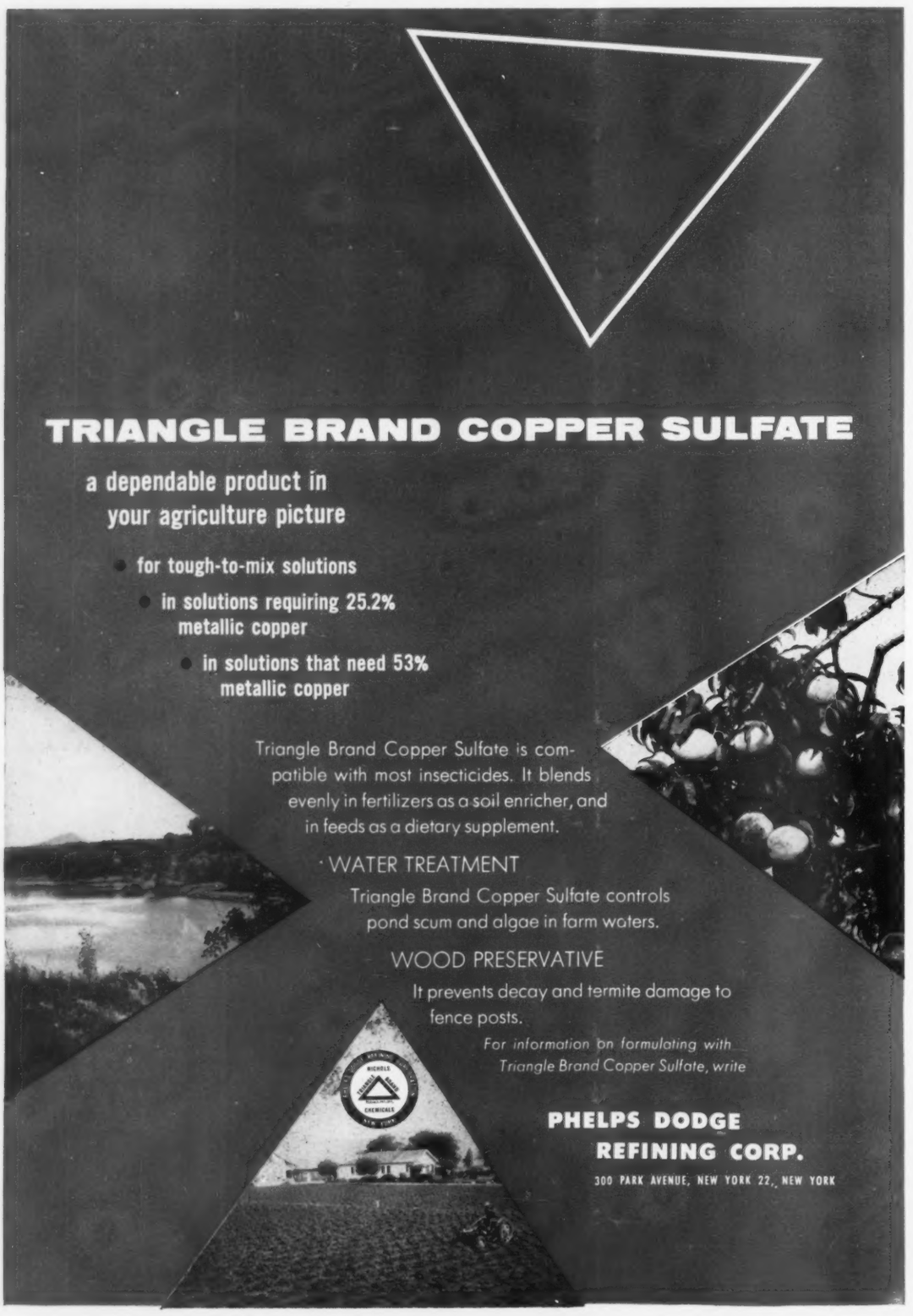
Notice that the surfactant X-77 with the lowest surface tension gave the greatest absorption, but the middle two surfactants having reasonably near the same surface tension—the one with the highest surface tension actually gave the greatest absorption. This led us to conduct the next test where the same wetting agents were taken and the concentration adjusted until we had very nearly the same surface tension.

TABLE 7. Effect of Different Surfactants at the Same Surface Tension on Foliar Absorption of Amitrol

Solution	Surface tension (dynes/cm)	Pct. Amitrol absorbed 24 hr.
Amitrol	69.6	12.2
Amitrol + Multi. C (.1%) ..	49.8	16.7
Amitrol + Multi. L (.5%) ...	47.5	37.2
Amitrol + X-77 (.013%)	50.9	51.0

Although surface tension of the solution was very nearly the same, one surfactant was outstandingly more effective in promoting absorption than the others. Obviously, there is something more subtle than mere reduction of surface tension involved in promotion of absorption by the surfactants. We have reason to believe from some of the studies that not only does a surfactant increase the contact between the spray and the

Turn to **SURFACTANTS** page 27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NEWS DIGEST OF THE WEEK

New Research Center Planned by Dow Chemical

MIDLAND, MICH. — The Dow Chemical Co. has announced plans to build a new agricultural chemical research center at company headquarters in Midland, Mich. Construction will begin immediately with completion scheduled for late next summer.

The new structure will consolidate agricultural chemicals research functions now dispersed among various laboratories at Dow's Midland plant, according to Dr. Julius E. Johnson, director of agricultural chemical research.

The center will house plant and animal science operations, some chemical synthesis, formulation and analytical work and serve as headquarters for Dow's country-wide program of field research. The new center will complement research facilities located at Seal Beach, Cal., and Freeport, Texas.

Sees Trend Toward More Liquid Insecticides

MONROE, LA.—The trend toward liquid insecticides in the Southeast is continuing at a rapid rate, according to records kept at the Cotton States Chemical, Inc. A few years ago the plant was formulating several times as much dust as liquids, but now the output has been reversed.

"Our dust plant is running only part-time," said Richard Petrus, production manager, "while the liquid plant is running at full capacity. This year 90% of our production is in the liquid form."

Mr. Petrus attributes this change to the fact that farmers think liquids are easier to apply and are more effective.

Dorr-Oliver Elects

STAMFORD, CONN. — Lloyd R. Boling was elected executive vice president of Dorr-Oliver, Inc., at a recent meeting of the board of directors. Mr. Boling was previously vice president for operations coordination. He will now carry responsibility for administration of the operating affairs of both the parent company and subsidiaries.

T. Bartow Ford was named vice president of the company with responsibility for all activities involving design, engineering and sale of complete plants.

To succeed Mr. Ford, the board elected Glen G. Reed vice president for sales. Mr. Reed was formerly general sales manager of the firm.

J. D. Hitch, Jr., president, will devote a major share of his efforts to corporate policies and long-range planning.

Memorial Fund Established For Late C. C. Alexander

NEW YORK—Establishment of the C. C. Alexander Memorial Scholarship Fund at Purdue University has been announced by Dr. George R. Ferguson, president of Geigy Agricultural Chemicals. The scholarship, in memory of Mr. Alexander who died in an airplane accident on May 12, 1959, was initiated at the suggestion of many of Mr. Alexander's friends both within and without the chemical industry where he was well known.

Mr. Alexander was research manager of Geigy and an alumnus of the entomology department of Purdue University, class of 1938.

Contributions may be made directly to the C. C. Alexander Memorial Scholarship Fund, Purdue Alumni Scholarship Foundation, Lafayette, Ind., according to Dr. Ferguson. The Geigy firm has made a major contribution to the fund in recognition of Mr. Alexander's years of service to the company and for his contributions to the field of agriculture as well as to mark their high esteem for him as an individual.

Chemical Exhibition to Feature Processing and Materials of Industry

NEW YORK—The 27th Exposition of Chemical Industries scheduled to be held in the New York Coliseum Nov. 30 to Dec. 4, will feature the exhibits of more than 450 manufacturers. Displays will include chemical processing equipment, chemical materials, and new processing methods.

One section will be devoted to chemicals, another to laboratory

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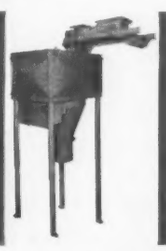

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equipment and supplies, and still another to processing equipment. The latter will include agitators, ammoniators, blenders, blowers, heat exchangers, impregnators and numerous other devices.

Other displays will include packaging equipment and products including information on sealing and labeling, packing, inspecting and counting.

Admission to the exhibition will be by invitation and registration only, according to officials of the event.

St. Regis Moves to Acquire Lone Star Bag Co. Stock

NEW YORK—St. Regis Paper Co. has filed with the Securities and Exchange Commission a registration statement relative to the issuance of shares of St. Regis common stock to be offered in exchange for the 44,235 outstanding shares of common stock of Lone Star Bag & Bagging Co., Houston, Texas.

The proposed offer would provide that a total of not more than 30,000 shares of St. Regis common stock would be issued on the basis of six thousand seven hundred eighty-two ten-thousandths (.6782) of a share of St. Regis stock for each share of Lone Star Bag stock.

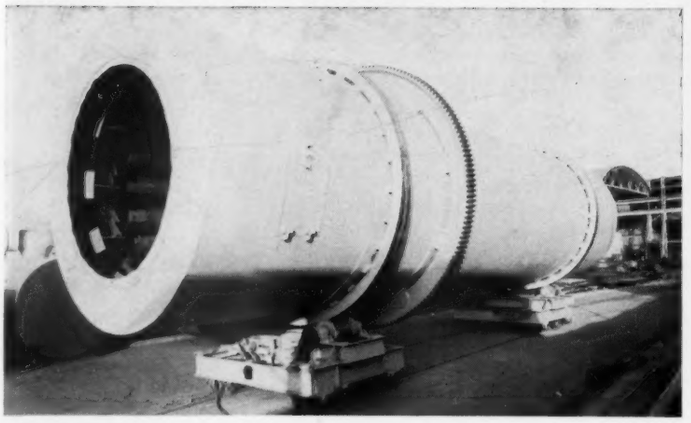
Lone Star owns approximately 83% of the outstanding capital stock of Wagner Bag Co., Inc., of Utah, and 43.7% of the outstanding capital stock of Lubbock Bag Co. of Lubbock, Texas. It is contemplated that the Lubbock Bag Co. will be merged into Lone Star prior to the completion of the exchange of St. Regis shares for Lone Star shares and the proposed offer of St. Regis stock for 44,235 outstanding shares of Lone Star includes 4,235 shares of Lone Star to be issued in connection with the merger of Lubbock. Net sales of Lone Star in 1958 were in the neighborhood of $16 million.

Liquid Chemical Tanker to Join Dow's Water Fleet

MIDLAND, MICH. — Keel laying for a new liquid chemical tanker which will be added to the Dow Chemical Co.'s fleet took place Wednesday, July 1, at Quincy, Mass. The vessel, as yet unnamed, is scheduled for launching about March 1, 1960. She is scheduled for delivery in June, 1960.

The vessel will join the "Marine Chemist" and "Marine Dow-Chem" in transporting Dow products to customers and interchanging chemicals among units of the Dow organization.

She will call at Dow's Texas division on the Gulf Coast, the Louisiana division on the lower Mississippi River, the western division on the Pacific Coast, and the Allyn's Point division on the Atlantic Coast. The vessel will also be able to carry light cargoes into the Great Lakes through the St. Lawrence Seaway and make contact with other Dow divisions located on water.



DESTINED FOR CUBA—This spheroidizer, made by Standard Steel Corp., Los Angeles, is en route to Matanzas, Cuba, for use in a fertilizer plant. The device will be used for making pelleted fertilizers out of solutions and slurries without use of a prilling tower, according to the manufacturers. In this process, slurry is sprayed into a rotating drum and hot air is introduced into the flow of the particles for making ammonium phosphate, ammonium nitrate, ammonium sulfate, ammonium nitrate-limestone, urea, superphosphates and complex fertilizers.

Florida Tonnage Reported

TALLAHASSEE, FLA.—Consumption of fertilizer materials in Florida for the month of May, 1959, totaled 72,279.87 tons, according to a report just issued by Nathan Mayo, commissioner of agriculture for the state. During the same period, mixed fertilizers totaled 158,911.23 tons, the report said.

New Mexico Fertilizer Use During 1st Quarter Forecasts Record Year

UNIVERSITY PARK, N.M.—First quarter shipments of commercial fertilizer into New Mexico indicate that a new record for fertilizer use may be in the making, says Gordon B. Hoff, agronomist with the New Mexico State University Extension Service.

Tonnage for the January-March quarter totaled 21,586, which is a fair proportion of the 37,873 tons and 38,269 tons shipped in the entire years of 1958 and 1957, respectively, he pointed out.

The quarter's shipments went largely to the state's four top cotton-growing counties: Dona Ana, 5,556 tons; Chaves, 5,464; Eddy, 3,458, and Lea, 1,902. Over half of the tonnage shipped into the state in this period was 20, 45, and 46% superphosphate.

Fertilizer use in New Mexico has increased almost threefold in the last 10 years. Mr. Hoff attributes this gain to continuing low prices of fertilizer in relation to the increased profits that come to farmers from the use of recommended amounts. Improved farming methods and crop varieties with higher yield potential have helped increase the efficiency of fertilizers.

Joins Naugatuck

NEW YORK — Dr. Bogislav von Schmeling, a research plant pathologist, has joined the agricultural chemical research and development staff of the Naugatuck Chemical division, United States Rubber Co. He has been assigned to the biological research group working at the division's experimental farm in Bethany, Conn. His research area will be fungicides.

March Lime Sales

WASHINGTON—Domestic sales of agricultural lime during March amounted to 30,209 short tons or 13,126 tons more than March a year ago, reported the Bureau of Mines, U.S. Department of the Interior.

USDA Clears Label

WILMINGTON, DEL. — A label clearance by the U.S. Department of Agriculture will allow the application of toxaphene to land being grazed by meat animals, and also permit animals to be treated with toxaphene formulations for control of ticks, lice, flies and other destructive pests, announced the Hercules Powder Co.

SunOlin to use Montecatini Method to Make Urea in New $8 Million Plant in Delaware

NEW YORK—The new $8 million urea plant of SunOlin Chemical Co. now under construction at North Claymont, Del., will produce 200 tons a day by converting 120 tons of liquid ammonia from the Sun Oil refinery at nearby Marcus Hook, Pa. and 150 tons of gaseous carbon dioxide from SunOlin's steam methane reformer, according to information received at the company's press conference in New York June 22.

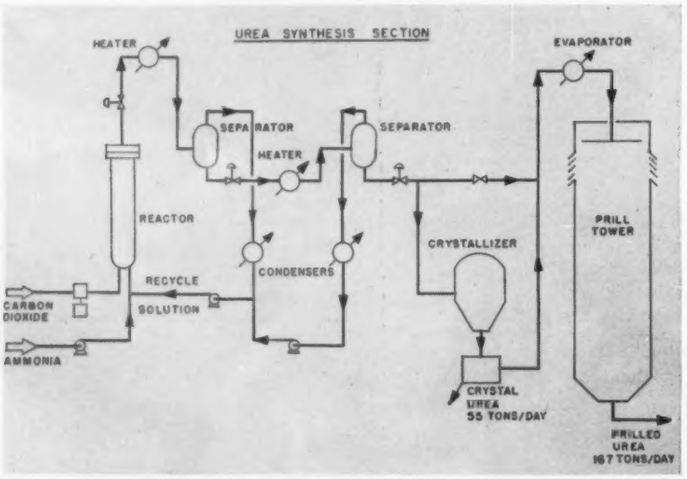
Further explanation of the process indicates that these two raw materials are compressed to 2,800 lb. per square inch and along with a recycled ammonia and carbon dioxide solution are fed to a reactor where about half of the feed is converted to urea and water. The balance of the stream from the reactor is ammonium carbamate. Some of the water and the ammonium carbamate, which decomposes to ammonia and carbon dioxide, are condensed and returned to the reactor. By recycling ammonia and carbon dioxide, the overall conversion to urea is expected to be over 95%.

Urea is recovered from the stream coming from the reactor by reducing the pressure and applying heat. Any remaining water is evaporated under a vacuum and the resulting molten urea is prilled in a tower.

In addition to making prills, some of the urea solution can be sent to a crystallizer where water is evaporated causing the urea to form crystals. After the crystals are centrifuged to remove water they are dried and bagged.

The plant will use the Montecatini process, developed by that company located in Milan, Italy. In this process, liquid ammonia and carbon dioxide gas are reacted at 2,800 pounds pressure and at 370° F. to form ammonium carbamate which then decomposes to urea and water.

"The SunOlin plant will be the only one of its size and type, and one of the few in the U.S. that completely converts ammonia and carbon dioxide to urea. It is also one of the few plants in the U.S. equipped to make both prilled and crystalline urea," a spokesman said.



UREA SYNTHESIS SECTION—Here is flow diagram of urea synthesis section of SunOlin Chemical Co. urea plant now under construction at North Claymont, Del. The new installation, costing $8 million, is expected to be in production by the end of February, 1960.

Ammonia and Superphosphate Production Up in April, 1959, Commerce Report Says

WASHINGTON — Production of a number of inorganic chemicals was higher in April, 1959, than was true of the previous month, or the same period of a year ago, according to a June 29 release of "Facts for Industry" issued by the U.S. Department of Commerce, Bureau of the Census.

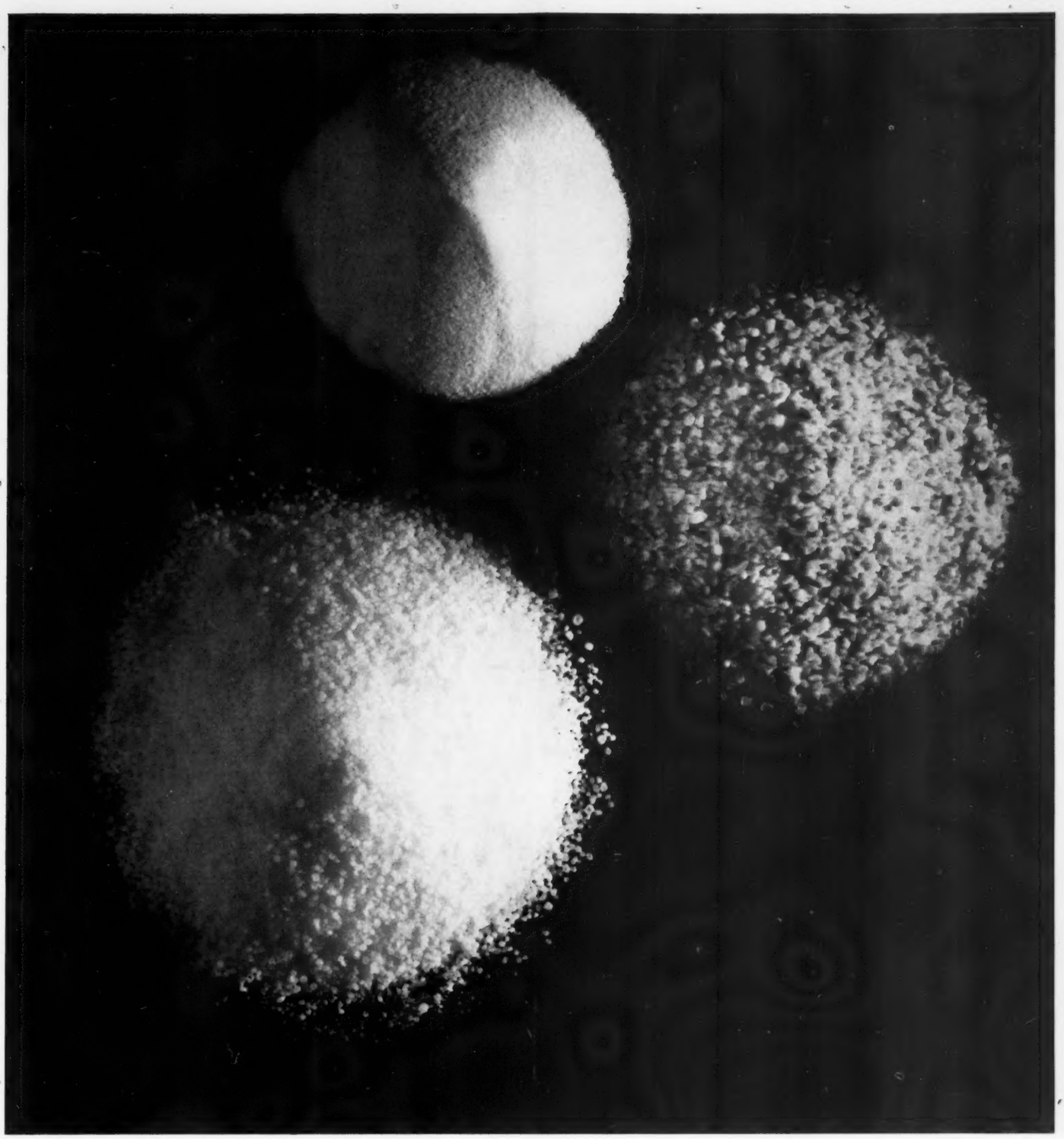
The table shows a comparative tally on production of some products.

Figures were also issued on production and shipments of superphosphate and other phosphatic fertilizers, for the months of April, 1958 and 1959.

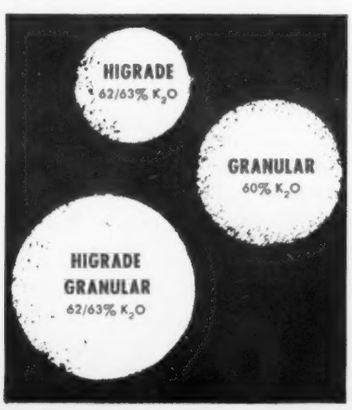
April production in 1959 amounted to 259,513 short tons (100% APA) compared with a total of 241,146 tons the same month of 1958. Shipments were also up approximately 14% over April's record in 1958.

Stocks held by producing plants as of April 30, 1959, totaled 184,666 short tons, or 39% less than those held on March 31, 1959.

Chemical	Production (short tons) April, 1959	March, 1959	April, 1958
Anhydrous Ammonia	400,156	384,128	329,837
Ammonium Nitrate (fertilizer grade)	215,618	222,768	208,512
Ammonium Sulfate—			
Tech. Synthetic	97,201	94,940	97,603
By-product	73,020	73,774	48,793
Nitrogen Solutions	109,235	87,249	82,337
Phosphoric Acid—			
From Phosphate Rock	98,206	100,138	95,151
From Phosphorus	69,971	66,760	61,925
Sulfuric Acid	1,595,879	1,579,878	1,296,892



Better fertilizers begin with three grades of specially sized USP potash



To help you make better fertilizers, USP offers *three* outstanding grades of muriate of potash—each ideally sized to meet current fertilizer manufacturing requirements. Two white grades—Higrade muriate and Higrade Granular muriate—each contains 62/63% K_2O, and each gives the most potash per ton for mixed fertilizers. And USP's Granular muriate, containing 60% K_2O, is ideal for fertilizers requiring a still larger particle size. All three grades are specially refined to resist caking and remain free-flowing throughout.

For complete technical data and shipping information, contact the United States Potash Company. Our expertly staffed Technical Service Department welcomes your inquiries.

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PRODUCTION EDITION

Editorial

Pilot Plant Demonstrations Show Industry New Production Methods and Procedures

BROAD ATTENTION was given to the recent pilot plant demonstrations conducted by the Tennessee Valley Authority at its facilities at Wilson Dam, Ala. Nearly 400 fertilizer industry production people were on hand to hear the talks, inspect the working pilot plants and to ask questions of various engineers and technicians on hand to answer such queries.

This issue of the Production Edition carries some of the highlights of the TVA meeting, including papers on both liquid and dry plant food manufacture.

Although there is still work to do toward perfecting better methods of ammoniation, granulation and other steps in the production of dry granular and pulverized plant food, a major portion of the attention was directed toward the liquid phase. It is in this area that more research and study need to be done and it is gratifying to see such important steps being taken in this direction.

The use of multinutrient plant foods in liquid is relatively new, but it has grown rapidly during its short history. Actually, very little information on problems of production and use was available when the practice first got under way. This was particularly true of plant design data which was then practically nonexistent.

Since that time, of course, the experience of plant operators and the efforts of research organizations and engineers studying the situation have changed the picture and there is now a considerable body of information on which producers and users may draw in working with their problems. Naturally, more information will be forthcoming as evidenced by the TVA meeting itself. Experience gained in the working of hundreds of liquid fertilizer plants in many portions of the country will also be a big factor in solving the problems now associated with this phase of manufacturing.

Probably one further note should be made, and that is a reminder that reports on projects being investigated in laboratories are still incomplete and should not be considered as all ready for use in operating plants. It should also be borne in mind that information from completed projects should be used with care because individual situations cover a range of factors which can't be treated fully in pilot-plant work.

The same is true of pilot plant studies on the manufacture of granular fertilizers in the TVA-type continuous ammoniator, although this phase of production has had a longer time for testing and commercial use in many plants in all parts of the nation.

In his introductory remarks at the demonstration, A. B. Phillips, chief of the process engineering branch of TVA, said that the methods and principles shown in the pilot plant demonstrations have been studied to a sufficient extent that he feels they can be used by industry. "It is recognized that pilot-plant studies do not produce all of the information that may be required for large-scale operations, but the industry has shown commendable initiative and competence in utilizing pilot-plant developments," he observed.

The fact that an increasing number of fertilizer industry people attend these demonstrations each year is evidence of keen interest in learning more about production procedures. This is underlined by the fact that these seekers come from practically every state as well as from a number of foreign countries. This attentive attitude is brought sharply into focus upon seeing the auditorium filled to overflowing with eager listeners jotting down notes on what the speakers say.

Misgivings on the part of the fertilizer trade concerning TVA's fertilizer distribution policies and competition in some quarters are hardly a factor in this phase of TVA's activities. The work done in its laboratories has gone a long way toward upgrading the industry's production potential. The fact that licenses to utilize TVA-type processes are granted without charge is in itself worthy of note.

The open discussion of fertilizer technology for the benefit of fertilizer productioneers is a step beyond the controversial aspects of TVA and most of those attending the demonstrations appeared willing to set aside, at least temporarily, their enmity toward the general setup. At the same time, however, the basic question of whether government has any business manufacturing and selling commodities in competition with private industry remains unsettled. There is no compromise on the position of industry on this score.

New Fertilizer Plants Seen As Boon to Yugoslav Economy

AS AN INDICATION of how basic to a nation's welfare is the fertilizer industry, the country of Yugoslavia plans to more than double its production of plant food within the next two years. This is to be a key move in the nation's five-year economic development plan.

According to reports, only 312,500 tons of fertilizer are expected to be manufactured in Yugoslavia this year, but the sights are aimed at production of some 750,000 tons by 1961.

Presently under construction are three nitrogen facilities and two phosphate plants. The nitrogen unit near Pancevo will make lime-ammonium nitrate (20.5% N), using natural gas piped in from 35 miles distance. Another nitrogen plant is at Lukavac which will utilize coke oven gas and the third will be set up in Sisak. It will utilize waste gas from an existing refinery nearby.

Phosphate plants are being built at Prahovo and Kosovska Mitrovica. The former will obtain sulfuric acid from nearby copper smelting works and the latter will get its sulfuric acid from waste material from a lead-zinc ore flotation.

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CROPLIFE is a controlled circulation journal published weekly. Weekly distribution of each issue is made to the fertilizer manufacturers, pesticide formulators and basic chemical manufacturers. In addition, the dealer-distributor-farm adviser segment of the agricultural chemical industry is covered on a regional (crop area) basis with a mailing schedule which covers consecutively, one each week, three geographic regions (South, Midwest and West) of the U.S. On the fourth week, production personnel in fertilizer manufacturing and pesticide formulating plants throughout the U.S. are covered in depth. To those not eligible for this controlled distribution, Croplife's subscription rate is $5 for one year ($8 a year outside the U.S.). Single copy price 25¢.

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Industry Meetings

July 7-9 — Pacific Northwest Plant Food Assn., 10th Annual Regional Fertilizer Conference, Tacoma, Wash.

July 15-17—Southwestern Fertilizer & Grade Meeting, Galvez Hotel, Galveston, Texas.

Aug. 12-13—Safety Training School, Cornell University Campus, Statler Inn, Ithaca, N.Y.

Aug. 18-19 — Midwestern Fertilizer Safety Training School, Offices of National Safety Council, Chicago, Ill.

Aug. 18-22—Canadian Fertilizer Assn., Bigwin Inn, Lake of Bays, Ontario.

Aug. 27-28 — Southeastern States Safety School, Heart of Atlanta Motel, Atlanta, Ga.

Aug. 28-29—Nitrogen Summer Educational Conference; University of Minnesota Farm Campus, St. Paul.

Sept. 24-25 — Annual Northeastern Fertilizer Conference, National Plant Food Institute, Biltmore Hotel, New York.

Oct. 13-14—Fall meeting, Western Agricultural Chemicals Assn., Villa Motel, San Mateo, Cal.

Oct. 21-23—National Agricultural Chemicals Assn. 26th annual meeting, French Lick-Sheraton Hotel, French Lick, Ind.

Nov. 4-6—Fertilizer Industry Round Table, Mayflower Hotel, Washington, D.C.; Dr. Vincent Sauchelli, National Plant Food Institute, chairman.

Nov. 5-6—Far West Fertilizer Safety Training School, Fresno, Cal.

Nov. 12-13—Southwestern Fertilizer Safety Training School, Houston, Texas.

Dec. 7-10 — Western Canadian and North Central Weed Control Conferences, Royal Alexandra Hotel, Winnipeg, Man., Canada.

CALENDAR FOR 1959-60

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New Appointments Made in Chase Bag Organization

NEW YORK—Chase Bag Co. has appointed Thomas A. Eadon, Jr., sales manager of its New York sales department. Mr. Eadon has been connected with the firm's Philadelphia branch since 1948. He was named sales manager at Philadelphia in 1956.

E. M. "Woody" Woodrich, who has been associated with the firm's Philadelphia branch as a sales representative in the Baltimore area, will succeed Mr. Eadon as sales manager in Philadelphia. He has been with Chase since 1953 and served as a salesman in Oklahoma before being assigned to Baltimore.

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SURFACTANTS

Continued from page 22

plant, but it softens the cuticle and opens it up for entry of the chemicals. It also conditions the chemical physically to keep it in a state from which it will be absorbed most readily by the plant.

Perhaps we should review the ground we have covered. On the basis of information available at present, we are able to make the following statements:

1. Surfactants definitely promote absorption of herbicides by the plant. They do this not only by increasing the rate by which the herbicides are absorbed but also increase the total amount absorbed.

2. Increased absorption results in greater effectiveness of the herbicide or if absorption is not limited it insures greater uniformity of kill. The surfactant can serve as insurance under almost every situation. It insures against loss due to chemical breakdown, mechanical loss from wind, or washing away by water.

3. We have established that surface tension alone is not the best criteria given us of a surfactant. The interaction of a surfactant with an herbicide is more subtle than that.

4. We have shown that not all surfactants are equally good with different materials. It definitely appears that a particular surfactant may be good with a given chemical but that it may not be universally effective with other materials.

We are prepared, therefore, to say with complete assurance that the use of the proper surfactant is justified in herbicide applications.

Government Group Sees More Use of Wet Phosphoric

WASHINGTON—A prediction that direct use of wet-process phosphoric acid in mixing, for upgrading the P_2O_5 content will accelerate in the future, is made in a recent report of the U.S. Department of Commerce, Business and Defense Services Administration. In its monthly industry report on chemicals and rubber production and consumption, the government agency said that direct use of wet-process phosphoric acid has developed substantially during the past two years.

"This development is a technological departure from the use of prepared dry phosphatic materials such as superphosphates, to the direct incorporation of liquid phosphoric acid into mixed fertilizers," the report said.

"The elimination from wet-process to phosphoric acid of certain impurities which cause settling out or sedimentation has given impetus to its direct use in fertilizer mixtures. Its improved quality may give it some cost advantages over acid made from phosphorus, which has been used to some extent in fertilizer mixing and liquid fertilizers, and for direct soil application.

"The substantial replacement of superphosphates by phosphoric acid is not necessarily indicated, but the economics of fertilizer processing, in some areas at least, appear to favor the use of acid along with normal superphosphate instead of concentrated superphosphate to make the higher analysis grades. The 6-year downtrend in consumption of normal superphosphate is expected to be reversed during the next few years, whereas the growth in use of triple superphosphate may level off or decline somewhat.

"Statistics on consumption of phosphoric acid in mixed fertilizers are not available, but analysis of production data for the acid, superphosphates, and other phosphatic fertilizer materials indicates some of the changing trends. Wet phosphoric acid output increased 15% in 1957 and continued to grow at about the same rate in 1958 to more than 1 million tons P_2O_5. In contrast, output of triple superphosphate, previously the main outlet for wet phosphoric acid, increased only 10 and 2%, respectively, in 1957 and 1958. Output of ammonium phosphates and miscellaneous phosphatic fertilizer materials kept pace percentagewise with that of phosphoric acid in 1957-58.

"Volumewise, the gap between phosphoric acid production and combined consumption for triple superphosphate, ammonium phosphates, and miscellaneous phosphatic materials has been widening. Although some of the wet acid goes into sodium or other phosphates for nonfertilizer uses, such outlets probably have not changed much in recent years and the new fertilizer use is believed to be largely responsible for increased consumption.

"Consumption of wet acid in fertilizer mixing is believed to have reached an estimated 50,000 tons P_2O_5 in 1957, and to have more than doubled in 1958. Several producers of triple superphosphate, who also make their own phosphoric acid, are reportedly diverting increased quantities of acid from superphosphate for shipment to mixers. A continuation of the upsurge in the latter use is foreseen in 1959, with the peak spring demand probably severely taxing shipping facilities."

Phosphate Production Up

ATLANTA, GA.—Georgia produced 133,203 tons of superphosphates and other phosphatic fertilizers in 1958, ranking fifth among all states in volume, according to the Atlanta field office of the U.S. Department of Commerce.

Classified Ads

Classified advertisements accepted until Tuesday each week for the issue of the following Monday.

Rates: 15¢ per word; minimum charge $2.25. Situations wanted, 10¢ a word; $1.50 minimum. Count six words of signature, whether for direct reply or keyed care this office. If advertisement is keyed, care of this office, 20¢ per insertion additional charged for forwarding replies. Commercial advertising not accepted in classified advertising department. Display advertising accepted for insertion at minimum rate of $11 per column inch.

All Want Ads cash with order.

SITUATIONS WANTED

PLANT OR PRODUCTION SUPERINTENDENT—Experienced in both large and small mixing plants. Have good knowledge all phases production and maintenance including superphosphate and granulation. Married, sober and a pusher. Address Ad No. 4934, Croplife, Minneapolis 40, Minn.

MACHINERY FOR SALE

FOR SALE—BEMIS 3-BUCKET ELECTRO-mechanical open mouth bagger, Series No. 6107, contact parts stainless steel, very accurate, available July 1, $1,000. C. Roy Curtis & Son, Inc., Marion, N. Y.

FOR SALE—SERIES 80600 E UNION SPEcial sewing machine, complete with adjustable sewing pedestal, adjustable sewing conveyor, driven by 1½ H.P., 220-volt General Electric motor. Used only in feed, excellent condition. Will sell reasonable. Contact: C. Roy Curtis & Son, Inc., Marion, N. Y.

HELP WANTED

SUPERVISORS FOR SHIFT SUPERVISION in dry fertilizer section of an integrated fertilizer plant located in Central California near medium sized city. Experience in wet-process phosphoric acid and pelleted ammo-phos based fertilizers essential. Will consider top operators with good education, background and experience. Send full details first time including salary requirements, present salary and availability. Address Ad No. 4975, Croplife, Minneapolis 40, Minn.

WANTED
Sales Executive

Responsible sales position. Challenging opportunity for imaginative, aggressive agrichemical graduate with experience in chemical sales. Position involves administration and sales with a progressive, fast-growing Midwest manufacturer of liquid fertilizer, insecticides and herbicides. Mail resume in strict confidence to: Ad No. 4928, Croplife, Minneapolis 40, Minn.

TECHNICAL SALES REPRESENTATIVE

Aggressive individual, age 25-35, to handle sales contacts in Southwest or Midwest area; also service experimental stations. Must have degree in Agriculture. Excellent opportunity to join staff of well-established basic agricultural chemical manufacturer. Send detailed resume and salary requirements to Velsicol Chemical Corp., 330 East Grand Ave., Chicago 11, Ill., attn.: Sales Mgr. Agricultural Chem. Div. All replies held strictly confidential.

BRUSH AND WEED KILLER—KILL SUBMERSED water weeds which foul up motor propellers, tangle fishing gear and choke irrigation ditches with R-H Granular Weed Rhap. Inexpensive, easy to use, sure results. For details write Reasor-Hill Corporation, Box 36CL, Jacksonville, Ark.

KILL BRUSH at low cost with amazing R-H Brush Rhap. Will not injure grasses, grains, cattle, or other animals. See your dealer, or write Reasor-Hill Corporation, Box 36CL, Jacksonville, Ark.

Renames Closure System

NEW YORK—Chase Bag Co. has renamed its new moisture-proof bag closure system to "Chasetite", the company has announced. The new term identifies the process more closely with its originating company, it was stated. "Chasetite" is a method of closing both ends of multiwall paper bags with a seal giving protection against penetration of moisture. (Croplife, April 13, page 8.)

DO YOU BUY ANHYDROUS AMMONIA OR NITROGEN SOLUTIONS?

Meet Ray Funk

Ray Funk is one of the men who have helped build Standard Oil's reputation for delivering NH_3 and Nitrogen Solutions on time and when promised. Working through Standard's traffic department shipments are expedited and followed closely to assure delivery. Ray's knowledge of such things as when the tank car will leave the area and the number of lines handling are what assure you that the car you've ordered will be coming onto your siding when it is due.

Ray keeps a running record of tank cars available, and he knows accurately the schedule of truck shipments. He is thus able to help customers estimate the delivery time on NH_3 and Nitrogen Solutions shipped by truck.

You don't learn this job overnight. Certainly Ray didn't. He's been in the Standard Oil sales department for 22 years. Thirteen of these years have been in customer service work. Many's the time Ray has been on the telephone at home after midnight making sure someone's shipment went through on time.

Is this the attention you would like your purchases of Anhydrous Ammonia and Nitrogen Solutions to receive? Well, it's the kind of care your order gets at Standard. Get all of the facts from your Standard Oil representative. Or write, **Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Ill.**

You expect more from STANDARD *and you get it!*